

ESSAYS ON ORGANIZATIONAL FORMS IN THE HEALTH CARE INDUSTRY

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ABSTRACT

One of the most visible recent changes in the organization of health care providers has been an increase in hospital integration, both horizontal and vertical. Understanding the effects of hospital affiliations is an important prerequisite to developing more effective health care delivery and reimbursement systems. This dissertation studies the nature and effects of two types of provider alliances: multihospital systems and hospital-physician affiliations.

Chapter 1 focuses on multihospital systems' effects on patients. In addition to allowing hospitals to take advantage of administrative economies of scale, system membership may facilitate access to capital and the coordination of patient care, ultimately affecting patient treatment. Combining information on multihospital system membership with Medicare data on heart attack patients between 1985 and 1998, Chapter 1 uses a regression model incorporating hospital fixed effects to measure the impact of multihospital system membership on heart attack patient treatments, treatment expenditures, and outcomes. The results suggest that for mid-sized and large hospitals in the 1990s, system status tends to be associated with higher-intensity treatments, lower expenditures, and few differences in mortality. Further analyses assess the extent to which service offerings and procedure volumes vary by system type.

The remainder of the dissertation examines hospital-physician affiliations. Hospital-physician entities such as physician hospital organizations could conceivably serve as the foundation for a new type of delivery system, capable of improving the quality and efficiency of care. Chapter 2 examines the characteristics contributing to the growth and evolution of hospital-physician affiliations during the 1990s. Chapter 3 then tests whether hospital-physician affiliations have had an impact on patients. If these new types of organization are little more than contracting vehicles or attempts to gain market power, they will show little effect on patient treatment. If they facilitate information development or realign incentives, however, they could fundamentally change the nature of patient care. Regression results indicate that in the mid-1990s, hospital-physician affiliations were sometimes associated with more intensive treatments, but that in general they have had little effect on the treatment, treatment expenditures, or health outcomes of heart attack patients.

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ABBREVIATIONS

AHA	American Hospital Association
AMI	Acute myocardial infarction (heart attack)
ARF	Area Resource File, a county-level database of health provider data
CABG	Coronary artery bypass graft (bypass surgery)
DRG	Diagnosis-related group (a category in Medicare's disease- and procedure-based payment system)
GPWW	Group practice without walls
HCFA	Health Care Financing Administration
HMO	Health maintenance organization
HPA	Hospital-physician affiliation; generic term which may include IPA, PHO, MSO, ISM, MF, equity model, GPWW. <i>Low-integration HPA:</i> IPA or PHO <i>High-integration HPA:</i> MSO, ISM, MF, equity model, or GPWW
IPA	Independent practice association
ISM	Integrated services model (salary model)
MF	Medical foundation
MSA	Metropolitan statistical area
MSO	Management services organization
PHO	Physician-hospital organization
PTCA	Percutaneous transluminal coronary angioplasty (angioplasty)

1 The Relationship Between Multihospital System Membership and Treatments, Expenditures, and Outcomes for Medicare Patients with Acute Myocardial Infarction

Over the last ten to twenty years, the proportion of hospitals affiliated with other hospitals has grown. In 1985, for example, 38% of non-public general medical-surgical hospitals reported being members of health care systems; by 1998, this percentage had grown to 66%.¹ Clement et al. (1997) report that between 1982 and 1989, the percentage of urban hospitals that joined strategic alliances with other local hospitals increased from 18% to 29%, and that by 1996 55% of urban hospitals had become members of a local hospital combination. The rise of the multihospital system, like other changes in the organization of the provision of medical care, prompts the question of whether patient care has been affected.

Understanding the nature of multihospital systems is a critical first step in answering this question. The potential motivations for joining a system are many. They include cost savings achieved through centralized administration, information systems, and purchasing. System membership may facilitate hospitals' (especially small hospitals') access to capital, management expertise, and medical services, including physician services. It may also improve the ability of hospitals to participate in managed care contracting, which can help generate admissions.² System membership can also generate admissions by increasing referrals.³

¹ These statistics are based on non-governmental general medical-surgical hospitals within the 50 states and Washington, D.C., that were included in the American Hospital Association Annual Survey.

² A survey of CEOs of rural hospitals (Hudson (1995)) found that the three most commonly cited reasons for formal affiliations with hospitals or health systems were managed care contracting opportunities (77%), improvement of clinical services (which the author interprets as enhancing access to clinical services rather than providing services on site) (51%), and improvement of physician staffing and recruiting (40%).

³ Berry & Seavey (1994) note that although many small hospitals are not involved in systems, they remain attractive to regional systems hoping to build referral networks. Small hospitals can generate

The potential effects of being in a system are as varied as the potential motivations for joining. While a number of previous studies have examined the influence of system membership on aggregate hospital costs and revenues (see, e.g., Clement et al. (1997), Menke (1997), or the literature review in Ermann & Gabel (1986)), this study expands on previous literature by assessing the effects of system membership on patients. In addition to revisiting questions about the effect of system membership on mortality (see Gaumer (1986) and Shortell & Hughes (1988)), it explores the effect of system membership on the provision of particular types of services. Specifically, this study uses information about Medicare patients admitted to for-profit or private not-for-profit acute care hospitals between 1985 and 1998 with a primary diagnosis of acute myocardial infarction (AMI, or heart attack), to determine whether multihospital system membership affects hospital transfer decisions, treatment intensity, Medicare payments, or health outcomes for individual patients.⁴ The study assesses whether system hospitals are able to generate lower Medicare expenditures and/or better outcomes relative to independent hospitals, and examines transfers, treatments, and service offerings to provide insight into what might produce differences in expenditures or outcomes.

Section 1.1 discusses the hypotheses underlying the study. Section 1.2 describes the hospital and patient data used as well as the methodology for identifying multihospital system members. Section 1.3 presents the form of the regression analysis and uses the regression results to explore the relationship between system membership and the treatment of individual heart attack patients. Section 1.4 expands on these results

substantial referrals. In a study by Parsons & Bateman (1998), physicians at one 20-bed hospital and at one 21-bed hospital in a rural county referred 493 patients over a three-month period; 16% of these patients were referred to tertiary care hospitals for inpatient care.

by looking at the relationship between system status and the provision of cardiac services. Section 1.5 examines whether system hospitals' patients are more or less likely to be treated at high-volume facilities. Section 1.6 considers the methodological challenges inherent in regression-based analyses of the impact of systems. Section 1.7 concludes.

1.1 How Might System Membership Affect the Treatment of Patients?

This study tests the hypothesis that multihospital system membership ultimately has an effect on patient care. It is possible that system formation has no effect at all on patient care. If, for example, hospitals create affiliations solely to take advantage of administrative efficiencies, there is little reason to expect that system formation will change patient treatment. If systems indeed have no impact on patients, then the only policy concern raised by affiliations or mergers is their potential for increasing market power and therefore prices in the market for hospital services. As explained in this section, however, it is possible that the formation of multihospital systems leads to more or fewer transfers of patients, more or fewer procedures provided, higher or lower expenditures, or better or worse health outcomes. To the extent that this study finds that affiliations affect patient care, policy analyses should take these effects into account.

1.1.1 Changes in Information

One way in which multihospital systems may affect the treatment of patients is by lowering the costs of information transfer. While system affiliations are not likely to affect treatments for conditions for which there is a standard, widely-accepted treatment, they may affect treatments for acute myocardial infarction, for which treatment protocols are evolving. Treatment patterns vary across the country, and a number of studies have

⁴ Members of multihospital systems are identified using American Hospital Association data. The procedure for classifying hospitals into nine system types is discussed in Section 1.2.2.

shown that physicians are strongly influenced by their peers. Soumerai et al. (1998), for example, shows that discussions and consultations of peer “opinion leaders,” combined with performance feedback, accelerated adoption of certain (nonsurgical) treatments for AMI. Escarce (1996) discusses how information about procedures is transmitted, and suggests that information externalities in hospitals help explain the rapid spread of technologies. If system partnerships lead to greater communication among the staff of member hospitals, then information about technological developments in the treatment of AMI may spread more rapidly among system partners than among independent hospitals.

Imagine, for example, a large urban hospital where the use of a particular procedure is growing rapidly (as indeed were the cardiac procedures considered in this chapter). If physicians on staff at the urban hospital travel to a smaller system partner in an outlying area (perhaps to provide outpatient specialty services), they may discuss the benefits of the procedure with physicians on staff there, increasing the likelihood that system partner staff will recommend the procedure to their patients. Hospitals may also provide information about technological developments more formally; continuing education programs for clinical personnel have been cited as one benefit of system partnerships (McKay (1998)).⁵ While the same sort of information transfer may occur at hospitals that lack formal affiliations, closer ties between system hospitals may make information sharing between their staffs more likely.

A related argument is that system hospitals may be able to develop transfer protocols more easily than independent hospitals. In a 1998 article examining procedure

⁵ Hospitals often reach out to physicians on both their own and other hospitals' staffs. Over 70% of respondents to a 1988 AHA-sponsored survey on medical staff marketing reported subsidizing continuing medical education programs, while over 43% reported having an outreach program for referring

use for AMI patients admitted to Veterans Affairs hospitals, Wright et al. find that between 1988 and 1994, cardiac procedure use grew and patient survival improved most for patients initially admitted to hospitals that did not have on-site invasive cardiac services. They speculate that the relative growth in procedure use may be due to “improvements in system protocols for inter-hospital transfer and better inter-hospital clinical integration.” If system hospitals face lower transaction costs in developing such protocols because of their affiliation, they may be more likely than independent hospitals to transfer patients for treatment.

If system hospitals transfer more and their patients receive more cardiac procedures, the Medicare expenditures on behalf of patients and patient mortality rates may be affected. The provision of cardiac services will raise Medicare payments since Medicare pays more for patients who receive these procedures. As described in more detail in Section 1.2.4, Medicare generally pays a fixed amount to a hospital based on the patient's diagnosis and treatment. When a patient is transferred, Medicare pays the transferor hospital a per diem rate, in addition to paying the standard fixed amount to the transferee hospital. This double payment will result in higher Medicare expenditures. If the higher procedure rate is medically appropriate, patients' mortality rates may decrease.

While the previously discussed information- and coordination-based hypotheses imply a higher transfer rate, another communication-based hypothesis implies a lower transfer rate. If staffs of affiliated hospitals are better able than independent hospital staffs to coordinate care for a patient without physically moving the patient, then the patients may have a lower likelihood of transfer, lower Medicare expenditures, and

physicians outside their main service area designed to facilitate consultations with specialists. See Perry (1989).

possibly better outcomes (because they receive the same quality of care without the physical disruption of being moved).

1.1.2 Service Consolidation

In addition to affecting patient treatment by facilitating information transfer, system membership may affect patient treatment by changing the financial incentives of member hospitals. An independent hospital that chooses not to offer cardiac services must transfer its patients for treatment, and thus loses the additional revenue associated with treating the patient.⁶ Independent hospitals may therefore be reluctant to transfer patients, instead choosing to provide cardiac services themselves.⁷ A local system hospital faces different incentives. If a system hospital's patients are transferred to a system partner to receive cardiac services, and there are financial ties among the system partners, then the system hospital has less to lose than an independent hospital as a result of the transfer. In fact, a system may consciously choose to consolidate services in order to reduce fixed costs and exploit economies of scale.⁸ A system consisting of a small and a large hospital, for example, might maximize net revenue (or profits) by not offering catheterization services at the small hospital (thereby saving operating costs), and

⁶ The need for cardiac procedures plays an important role in determining transfer rates. Using Medicare records from fiscal year 1987, Buczko (1993) finds that three top DRGs for transfer admissions were coronary bypass with cardiac catheterization (7.9%), percutaneous cardiovascular procedures (6.8%), and coronary bypass without cardiac catheterization (5.7%).

⁷ This analysis assumes that treating AMI patients is profitable. If the patient's treatment costs are likely to exceed the revenues associated with treating the patient, the hospital would actually prefer to transfer the patient to an unrelated entity. Ellis & Ruhm (1988) point out that a hospital can avoid anticipated losses by transferring patients. Newhouse (1989) finds little evidence that unprofitable patients are systematically transferred, however, and notes that peer review organizations review transfer cases to enforce antidumping provisions in the law.

⁸ While systems may have financial incentives to consolidate the provision of services, one study by Deloitte & Touche has found that over half of hospitals that merged or joined networks did not consolidate clinical services (see Snail & Robinson (1998)). Even hospitals expecting to consolidate services struggle to implement their plans. It may take five to eight years for combining hospitals to consolidate services (Blecher (June 20, 1998)). Delays of this magnitude would make differences between system hospitals and independent hospitals difficult to detect in studies spanning only a few years.

transferring patients of the smaller hospital to the large hospital to receive services.⁹ A system may choose to take this step even if the smaller hospital could break even were it to provide services itself. Independent hospitals, in contrast, would choose to provide the services themselves if they could at least break even.¹⁰

The consolidation of services may ultimately affect transfer rates, procedure rates, Medicare expenditures, and mortality. Consolidation increases the need to transfer patients, and as a result, may increase Medicare expenditures (as explained previously). At the same time, it may reduce Medicare expenditures by reducing the number of hospitals that offer cardiac services, thereby reducing the overall likelihood that patients receive procedures. Previous studies have found that patients initially admitted to hospitals lacking treatment facilities are less likely to receive treatment. In a study of AMI patients admitted to Seattle-area hospitals, Every et al. (1993) finds that patients admitted to hospitals with on-site cardiac catheterization facilities were far more likely to undergo coronary angiography than patients admitted to hospitals where transfer would be required. Blustein (1993) finds a similar result for catheterization, as well as disparities for angioplasty and bypass surgery. If these disparities result from patients selecting hospitals that provide services the patients know they will need, then consolidation would have little effect on procedure rates or Medicare expenditures (see Hodgkin (1996)). On the other hand, if physicians are more likely to suggest undergoing procedures when in-hospital availability makes them more convenient for the patient (and for the physician), then consolidation may result in lower procedure rates and Medicare

⁹ Buczko (1993) finds that small and rural hospitals tend to send transfers to large urban hospitals of 200 beds or more, and receive relatively few transfers themselves. He does not examine the role of system affiliation.

payments. The effect of any differences in procedure rates on mortality depends on the clinical appropriateness of the procedures.

Regardless of its effect on procedure rates, consolidation may boost survival rates of system patients by increasing the likelihood that they are treated in high-volume facilities. For example, a mid-sized hospital may decide not to offer cardiac services if it could do so only at a relatively low volume, when it could instead transfer its patients to a higher-volume partner. Several studies have tested the hypothesis that cardiac procedure volume affects mortality rates. Grumbach et al. (1995), for example, examining 1989 data on bypass surgery in New York and California, find the highest mortality rates among California hospitals performing fewer than 100 bypasses per year. Phillips et al. (1995), using data on patients undergoing PTCA in 1989 in 119 California hospitals, find that rates of adverse outcomes were significantly higher than expected in low-volume hospitals (<201 PTCAs), and lower than expected in high-volume hospitals (>400 PTCAs). If system hospital patients are disproportionately likely to receive treatment at high-volume facilities due to facility consolidation, patients initially admitted to system hospitals may have lower mortality rates.¹¹

1.1.3 Service Proliferation

Rather than driving the consolidation of cardiac service provision, the growth of multihospital systems (both local and nonlocal) may instead encourage the proliferation of cardiac services, for at least three reasons. First, multihospital systems may free

¹⁰ Independent hospitals could conceivably form affiliations specifically to provide services, but would likely face higher transaction costs than system hospitals, which may already have coordination mechanisms in place.

¹¹ See also Dudley (2000). It is unclear, however, whether higher procedure volumes actually cause the lower adverse outcome rates to the extent implied by the literature. If patients (or their physicians) can accurately judge the quality of the physician or institution performing the procedure, then

financial capital constraints on hospitals, especially smaller hospitals, and provide the financial resources to recruit physicians that the hospitals may not have been able to attract on their own. Less expensive financing and better access to physicians would allow smaller hospitals to offer services that they would not have been able to offer had they remained independent. One multihospital system reportedly “pumps about \$2 million annually” into the facilities it acquires for the first five years, brings in physicians, and adds services, including in some cases cardiac catheterization laboratories (Blecher (September 5,1998)). A study has shown that membership in investor-owned systems is associated with upgraded plant and equipment (see Shortell (1988)).

A second and related reason that system hospitals may be more inclined to offer cardiac services than otherwise similar independent hospitals is that they may exploit economies of scale in management. A multihospital system may have employees with considerable knowledge about developing, marketing, and operating cardiac services, for example, while an independent hospital may have difficulty (or face great expense in) acquiring the same knowledge either through its own employees or through consultants. If joining a system means that expertise in managing cardiac services can be acquired more cheaply, then system hospitals will be marginally more likely to provide these services.

A third reason that a multihospital system may choose to replicate the provision of cardiac services across its member hospitals is to maintain a consistent, high-tech image. Using 1988 California data, Dranove & Shanley (1995) compare local systems to “pseudo systems” composed of random collections of hospitals. They do not find that

patients will choose to go to high-quality institutions – so that high quality produces high volumes, not vice versa.

systems exploit economies of scale by providing fewer high tech services, such as open heart surgery or cardiac catheterization, relative to the pseudosystems. They instead find that system hospitals tend to maintain relatively homogeneous service mixes, allowing them to exploit economies of promotion. While a desire for consistent service mixes does not necessarily imply that system hospitals will provide consistently high levels of service (because they could alternatively provide consistently low levels of service), they may choose to do so to satisfy the demands of health care purchasers.

For the same reasons explained previously, service proliferation may affect transfer rates, procedure rates, Medicare expenditures, and mortality. Service proliferation will lower transfer rates, since patients need not be transferred solely to receive cardiac services. The proliferation of treatment facilities may result in higher procedure rates, as found by the studies described earlier. Lower transfer rates but higher procedure rates combine for an uncertain effect on Medicare payments. Finally, mortality may improve if a higher procedure rate proves medically beneficial, but any such improvement may potentially be offset by lower-quality care that may result if procedure volume is dispersed among multiple system facilities.

1.1.4 Summary: Potential Effects of System Membership on Patient Care

Table 1.1 summarizes the hypothesized effects of system membership on patient care:

Table 1.1 Hypotheses About Impacts of System Membership					
	Transferred	Catheter Within 90 Days	PTCA or CABG Within 90 Days	Log 90-Day Payments	90-Day Mortality
1) Information & coordination hypothesis: Information transfer and coordination less costly, so system hospital physicians more likely to suggest procedures and/or develop transfer protocols	+	+	+	+	- if procedures medically appropriate
2) Communication hypothesis: Communication less costly, so patients remain in initial admission hospital unless transfer necessary	-			-	- if transfers hurt outcomes (all else equal)
3) Consolidation hypothesis: Because local systems retain revenues despite transfers, they are more likely to consolidate cardiac services	+	- if patients admitted to hosps without facilities get fewer procs	-	? transfers & procs have opposite effects	? fewer procs, done at higher volume facilities
4A) Service proliferation hypothesis: Local & nonlocal systems provide cheaper access to capital and/or management expertise, resulting in more in-house facilities	-	+ if patients admitted to hosps with facilities get more procs	+	? transfers & procs have opposite effects	? more procs, done at lower volume facilities
4B) Local & maybe nonlocal systems want to offer cath, PTCA and CABG at all member hospitals to preserve consistency					

1.2 Data and the Choice and Construction of Variables

1.2.1 Hospital Characteristics

Hospital information was taken from the American Hospital Association's Annual Survey of Hospitals for each year 1985 through 1998 (the AHA Survey). This study

includes all United States hospitals in the 50 states and Washington, D.C. identified in the surveys as general medical-surgical hospitals not controlled by local or federal government. Local and federal government hospitals were excluded because they may not face the same incentive structures as non-government hospitals, and because any system to which these hospitals belong may operate differently from other multihospital systems, since they may face more constraints on their behavior.¹² Table 1.2 shows the number of hospitals remaining in the sample after each successive stage of elimination. It also provides descriptive statistics in selected study years for various hospital characteristics.¹³

¹² Hospitals with AHA identifiers that could not be matched to Medicare provider numbers, as well as hospitals with various types of missing data, were also excluded.

¹³ Bed totals include adult general medical and surgical, other acute care, intensive care, and burn care beds, but exclude subacute, neonatal, pediatric, and obstetric beds. Where a bed total was missing, it was assumed to be the average of totals in the nearest nonmissing preceding and subsequent years. For-profit and religious status are taken directly from the AHA survey. A hospital is considered contract managed if it reports being so in the AHA survey. A hospital is classified as a teaching hospital if it reports having more than 20 full time residents.

Table 1.2
Hospital Characteristics in Selected Study Years

	1985	1990	1994	1998
<u>Sample Hospitals</u>				
# General Medical-Surgical Hospitals	5,915	5,531	5,274	5,026
Of these, # that are private non-profit or for profit	4,022	3,769	3,623	3,555
Of these, # that are matched to AMI patients	3,854	3,614	3,438	3,181
<u>Hospital Characteristics</u>				
% Under 100 Beds	46.3	48.9	52.8	56.8
% 100-250 Beds	35.9	35.6	34.1	32.3
% Over 250 Beds	17.9	15.5	13.1	10.8
% For Profit	18.9	18.2	17.5	18.4
% Religious	17.0	16.8	16.3	15.8
% Teaching	9.1	9.1	10.8	11.0
% Contract Managed	10.7	10.8	10.4	9.7

1.2.2 Multihospital System Membership

“A multihospital system” is not an easily defined entity. Types of hospital affiliations are as varied as the reasons for forming them. Systems may be comprised of two hospitals or 100. Systems may consist of for-profit (investor-owned) hospitals or nonprofit hospitals. Systems may or may not have a religious orientation. Some systems involve hospitals in the same local area, while others span regions or the entire country. Systems differ widely in the activities that they choose to integrate; some integrate only administrative services, for example, while others integrate clinical services. System hospitals may share a common owner or alternatively the same managing organization. It is unclear what sorts of affiliations should be classified as “system” affiliations.

Researchers have dealt with these issues in a multitude of ways. Many authors separate nonprofit systems from investor-owned chains (see, e.g., Halpern et al. (1992), Gaumer (1986) or Alexander & Morrissey (1988)). Halpern et al. (1992) also consider contract managed systems separately from other systems. Some authors, such as Luke et al. (1995), focus specifically on local (as opposed to national) chains. Others focus on

the characteristics of the hospitals involved in the affiliation. Clement et al. (1997), for example, examine an entity they term a local “strategic hospital alliance.” Strategic hospital alliances need not be formally recognized by the AHA, but they must involve hospitals that come together in a local market to compete with other providers. The authors further divide these alliances between tightly coupled alliances (where there is unified ownership) and loosely coupled alliances (an alliance that involves at least two owners), and between unimodal alliances (where one owner controls 70% of patient days or more) and bimodal alliances (where no owner dominates). In each study, the authors have tailored their system definition to the specific topic they were examining.

Like many other researchers, I begin by defining systems on the basis of AHA data. The AHA defines a multihospital system as two or more hospitals owned, leased, sponsored, or contract managed by a central organization. While the AHA takes steps to validate its listings (in particular, contacting system headquarters to verify the hospitals that constitute the system), the system data and the responses in the AHA Survey contain discrepancies. For example, in the 1998 survey, 24% of nongovernmental general medical-surgical hospitals that report being part of a health care system do not have an AHA-assigned system identifier, while 11% of hospitals that have a system identifier fail to report being in a system. Potential explanations for the discrepancies include differences in the time frame considered by the AHA and the survey respondents in assessing system membership status, and differences in perceptions about what constitutes a health care system. In light of the discrepancies, however, I have supplemented the AHA-assigned system identifier with additional information provided by the hospitals.

Any hospital with an AHA-assigned system identifier for a particular year was assigned the same identifier for the purposes of this study. But identifiers were also assigned to some hospitals without AHA-assigned system identifiers who nonetheless identified themselves in the AHA survey as being system members. When at least two hospitals reported the same system name, but the system name was not reported in the AHA Guide to the Health Care Field listings for the corresponding year, a system identifier was manually assigned. System identifiers were also assigned when hospitals reported being members of systems that were ever listed either in the AHA Guide (between 1985 and 2000) or in system lists prepared by *Modern Healthcare*. After system members were identified, a gap-filling algorithm was used to ensure that missing data did not result in a hospital suddenly disappearing from, then reappearing in, a hospital system. Finally, to retain its system status, a hospital must have had at least one partner that fulfilled the study inclusion criteria.

After hospitals were assigned system identifiers, they were classified into either local or nonlocal systems. Whether a hospital has local partners matters because the hypotheses about service consolidation, and to a lesser extent information transfer, require that system partners be within reasonable traveling distance. System hospitals that do not have local partners still need to be separated from completely independent hospitals, however, since the hypotheses about access to financial capital and management expertise apply to nonlocal as well as to local systems. System hospitals were therefore classified into “local” systems if they had at least one partner less than 100 miles away, and into “nonlocal” systems if no partner was less than 100 miles away. The

"nonlocal" and "local" system labels were applied to individual hospitals, not to entire systems.

Table 1.3 compares characteristics of system and independent hospitals for the first and the last study year. System hospitals are far more likely than independent hospitals either to be for-profit or to have a religious affiliation. Among local system hospitals this gap decreased substantially between 1985 and 1998. Local system hospitals were on average smaller than independent hospitals in 1985, but larger than independent hospitals in 1998, while nonlocal system hospitals were smaller than independent hospitals in both periods. Relative to independent hospitals, nonlocal system hospitals are disproportionately located in rural areas and small cities, while local system hospitals are disproportionately located in the largest urban areas. Perhaps the biggest difference between system and independent hospitals is their distribution across the country. System hospitals tend to be located in the South Central, Mountain, and Pacific regions, while independent hospitals dominate in the New England, Mid-Atlantic, and North Central regions. While these differences in hospital characteristics could conceivably complicate the task of separating the effects of systems from the effects of other factors, the inclusion of certain of these variables in the regression analyses (such as for-profit status and hospital size), along with the inclusion of hospital and year fixed effects, should address this problem.

Table 1.3
Independent and System Hospital Characteristics in Selected Study Years

	1985				1998			
	System Affiliation Type				System Affiliation Type			
	Local	Non-local	All	Indep.	Local	Non-local	All	Indep.
# of Hospitals	1409	423	1832	2022	1721	262	1983	1198
Hospital Type								
% Nonprofit (NP)	40.0	29.8	37.6	88.1	54.6	35.5	52.1	88.6
% Religious NP	26.1	38.5	28.9	6.1	21.9	25.2	22.3	5.0
% For-profit	34.0	31.7	33.5	5.7	23.5	39.3	25.6	6.4
Hospital Size								
Mean Beds	149	138	146	156	132	94	127	104
% 0-100 Beds	46.8	48.7	47.3	45.4	50.8	70.6	53.4	62.5
% 100-250 Beds	36.1	35.2	35.9	35.8	35.5	23.3	33.9	29.7
% 250+ Beds	17.0	16.1	16.8	18.8	13.7	6.1	12.7	7.8
MSA Size								
% Rural	34.6	43.7	36.7	39.9	33.9	49.2	36.0	47.3
% Under 250k	10.9	13.0	11.4	10.7	9.9	16.0	10.7	11.4
% 250k-1m	19.7	23.9	20.6	19.4	22.6	21.0	22.4	18.0
% 1m+	34.9	19.4	31.3	30.0	33.6	13.7	31.0	23.3
Region								
% New England	1.8	2.4	1.9	9.1	3.3	2.3	3.1	8.2
% Mid-Atlantic	6.6	5.0	6.2	19.3	11.5	3.1	10.3	17.9
% South Atlantic	15.5	13.2	15.0	13.5	16.5	15.3	16.3	14.9
% North Central	25.6	27.2	25.9	32.9	27.3	24.1	26.9	32.8
% South Central	26.5	24.8	26.1	13.2	23.2	23.3	23.3	13.9
% Mountain	7.0	11.8	8.1	3.5	5.6	15.7	6.9	4.6
% Pacific	17.1	15.6	16.8	8.6	12.7	16.4	13.2	7.9

Most of the analyses in this paper use a system definition that incorporates information about admission hospital and system partner size, in addition to the basic local or nonlocal categorization. Hospitals were stratified first according to their own size. A “small” hospital has fewer than 100 beds, a “medium” or “midsized” hospital from 100 to 250 beds, and a “big” hospital more than 250 beds. The effects of being in a nonlocal or local system were analyzed separately for each group. In addition, for each

size-local system combination, hospitals were classified according to whether they had a “big” system partner within 100 miles.¹⁴

Stratifying system hospitals by size in the regression analyses facilitates the interpretation of the results. For example, if system hospitals consolidate the provision of services in their largest system member, then a positive correlation between transfer rates and multihospital system membership might be visible for small system members, but not for big system members. If hospitals were not stratified by size, the impact of system membership would be harder to detect. Second, if big hospitals are more likely than small hospitals to offer sophisticated cardiac services, information is more likely to flow from big hospitals to small hospitals. A difference in treatment patterns would again be visible for patients initially admitted to small hospitals, but not for patients initially admitted to large hospitals. Third, consolidation of services may be more likely if merging hospitals have different degrees of specialization (see Snail & Robinson (1998), citing Bogue et al. (1995)). If so, consolidation of cardiac services may be more likely when a small hospital partners with a large hospital than when two medium-sized hospitals partner. Finally, most small hospitals could not profitably provide high-tech cardiac services, but many medium-sized hospitals can. For this reason, system-based decisions about consolidating services or offering new services are more likely to affect mid-sized hospitals than small hospitals.

This three-step classification produces nine mutually exclusive system categories. A hospital may be small, medium, or big; may be in a local system or a nonlocal system; and, if in a local system, may have a big partner or may not have a big partner. Table 1.4

¹⁴ The resulting classification is similar to the Clement et al. (1995) unimodal versus bimodal classification.

shows the distribution of study hospitals across system types, and the graph shows the relative growth of system types over time.

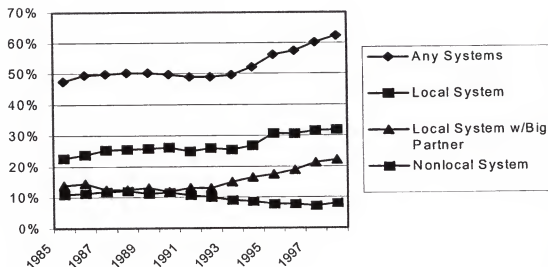
Multihospital system membership increased between 1985 and 1998, but not at a fast pace until the 1990s.¹⁵ One prominent pattern is the sharp growth in local system membership in the early to mid-90s, in contrast to the decline of nonlocal system membership over the same time period. For example, the percentage of small hospitals participating in local systems increased from 38% in 1990 to 48% in 1998, while the percentage of small hospitals participating in nonlocal systems dropped from 13% to 10%. Another trend is the increase in the prevalence of affiliations with big hospitals. The proportion of medium-sized hospitals affiliated with big hospitals increased from 14% in 1990 to 27% in 1998; this jump is mirrored by a jump in the proportion of big hospitals affiliated with (only) small or medium hospitals from 26% to 40%.

¹⁵ Fournier & Mitchell (1997) report that acquisition activities of multihospital systems slowed considerably during the late 80s and early 90s (see Relman (1991)).

Table 1.4
Percentage of Hospitals of Each System Type, by Hospital Size Category

Bed Size	System Type	1985	1990	1994	1998
Under 100	Local	25.1	27.5	26.5	30.2
	Local w/Big Partner	<u>12.0</u>	<u>10.3</u>	<u>15.6</u>	<u>18.1</u>
	Subtotal: Any Local	37.0	37.9	42.1	48.3
	Nonlocal	<u>11.6</u>	<u>13.1</u>	<u>9.8</u>	<u>10.2</u>
	Total: Any System	48.6%	50.9%	51.9%	58.6%
	Hospitals <100 Beds	1783	1769	1815	1808
100-250	Local	21.4	24.7	24.7	32.1
	Local w/Big Partner	<u>15.5</u>	<u>13.7</u>	<u>19.2</u>	<u>27.3</u>
	Subtotal: Any Local	36.8	38.4	43.9	59.4
	Nonlocal	<u>10.8</u>	<u>11.0</u>	<u>7.9</u>	<u>5.9</u>
	Total: Any System	47.6%	49.5%	51.8%	65.3%
	Hospitals 100-250 Beds	1382	1286	1171	1028
Over 250	Local	19.2	25.6	33.2	40.3
	Local w/Big Partner	<u>15.7</u>	<u>12.9</u>	<u>14.2</u>	<u>28.1</u>
	Subtotal: Any Local	34.8	38.5	47.4	68.4
	Nonlocal	<u>9.9</u>	<u>8.8</u>	<u>7.3</u>	<u>4.6</u>
	Total: Any System	44.7%	47.2%	54.7%	73.0%
	Hospitals >250 Beds	689	559	452	345

Figure 1.1
Percentage of Hospitals of Each System Type
1985-1998



Because hospital fixed effects will be used in the regressions, it is important to understand the changes in system status that will identify the effects of multihospital system membership. Over the 1985 to 1998 period, nearly 30% of study-eligible hospitals were never in a system, and 21% of hospitals were always in systems of the same type (local, local with big partner, or nonlocal). But almost a third of hospitals joined or left systems during the study period. In total, half of hospitals joined, left, or switched system types, contributing to the identification of the effects of system status on patient treatments, expenditures, and outcomes.

The system definitions used in this paper lack some of the detail of definitions used in the previously cited literature. While I have included factors such as contract management and for-profit status as separate regressors, I would like to include even more factors. An ideal system definition would incorporate information about ownership structure, for example. If a hospital does not have strong financial ties to its partner, it may be reluctant to give up its patients. It would also be useful to know the dimensions along which systems act like systems. Shortell (1988) hypothesizes that the effects of systems may be limited because system hospitals often do not behave as system partners; criteria for “systemness” might include the degree of commitment to common culture, system-wide financial planning, system-wide human resource planning, and service integration. Unfortunately, I do not have access to data describing the nature of the hospitals’ affiliations or the degree of their integration. Potentially strong effects of system partners that have integrated the provision of medical services may be masked by the lack of impact of systems that are only loosely coupled. Because of data limitations, I

look at an average system effect produced by systems at all levels of integration, rather than at the differences in effects associated with different degrees of integration.

1.2.3 Patient Data

Patients included in this study are non-HMO Medicare beneficiaries¹⁶ between the ages of 65 and 99 who reside within the 50 states or the District of Columbia and who were admitted to a study hospital with a diagnosis of acute myocardial infarction (AMI, or heart attack). Patient hospital records come from the Health Care Financing Administration's 100% sample MEDPAR tapes (which contain Medicare Part A claims), and additional information comes from HCFA's HISKEW tapes. Patients who have had an AMI within the previous year are excluded; the second AMI is treated as a readmission for the purposes of this study, and is attached to the patient's record for the initial AMI, or "index" admission.¹⁷

Of the patient sample pooled across all years, 50% are female and 5% are black. Twenty-one percent of sample patients are between the ages of 65 and 69, 24% between 70 and 74, 22% between 75 and 79, 28% between 80 and 89, and 5% between 90 and 99. Older patients appear to be disproportionately concentrated in smaller hospitals, and black patients disproportionately concentrated in larger hospitals.¹⁸ Over time, the most

¹⁶ The use of data from elderly Medicare patients raises the question of applicability to the population as a whole. Study findings may not be applicable to the general population in situations where insurance provisions or other contractual relationships affect the choice of hospital at which a patient is ultimately treated. Medicare patients are likely to account for a substantial proportion of people who have had AMIs, however, and so are an important study population even if the findings do not universally apply. In addition, to the extent that system membership affects hospital-level decisions such as which services to provide, the effects on Medicare and non-Medicare patients will be similar.

¹⁷ Additional patients were excluded for a variety of reasons. For example, patients who were discharged alive and whose short length of hospital stay implied that they did not actually have an AMI were excluded. End stage renal disease patients and patients whose records were missing various dates, such as the date of admission, were also excluded.

¹⁸ In hospitals with fewer than 100 beds, 36.3% of patients were over 80 and 3.7% of patients were black. In hospitals with more than 250 beds, 31.4% of patients were over 80 and 6.7% of patients were black.

striking trend in demographics is the growth in the percentage of older patients toward the end of the study period.¹⁹ The demographic characteristics of patients vary across admission hospitals with different system statuses. During the study period, for example, black patients comprise 4.7% of patients in large nonlocal system hospitals, but 7.5% of patients in large hospitals that have partnered with other large local hospitals. These demographic differences should not affect the analyses in this chapter, however, since demographic characteristics will be included as regressors in all of the patient-based analyses.

1.2.4 Dependent Variables

Table 1.5 shows the means of the regression dependent variables by hospital and system type. The dependent variables are intended to provide insight into the organization of care (through the transfer variable), treatment intensity, expenditures on care, and treatment outcomes. These variables, like the patient demographic characteristics, are those associated with the hospital to which the patient was initially admitted, not the hospital at which the patient ultimately received treatment.

A patient is defined to have been transferred if he or she was initially admitted to a hospital for an AMI, discharged from the initial admission hospital, and then admitted to a different hospital on the same day or the next day with a diagnosis of AMI, congestive heart failure, or ischemic heart disease.²⁰ Transfers may occur when a patient is admitted to a hospital that can provide some sort of emergency treatment or noninvasive assessment, but which is not equipped to provide more invasive procedures,

¹⁹ In 1985, 29.5% of patients were 80 or older; in 1998, 38.1% of patients fell in this age category.

²⁰ Any of these three diagnoses might in some cases call for diagnostic or treatment procedures such as catheterizations, percutaneous transluminal coronary angioplasties (PTCAs), or coronary artery bypass grafts (CABGs).

such as catheterizations, percutaneous transluminal coronary angioplasties (PTCAs or angioplasties) or coronary artery bypass grafts (CABGs). While some physicians may routinely recommend angiography and PTCA for most patients, the American College of Cardiology/American Heart Association Guidelines discourage this practice. Patients who are transferred are likely to be patients who are stable enough and survive long enough to be transferred and whose conditions suggest a potential benefit from more intensive treatment than the initial admission hospital is prepared to provide. Table 1.5 shows that transfers more than tripled over the study period. The transfer growth trend mirrors, and is likely the result of, equally dramatic growth in the provision of catheterizations and angioplasties.

Catheterizations and PTCA/CABG within 90 days are both indicator variables indicating whether the patient received the procedure within 90 days of his or her initial admission. They measure treatment intensity. A catheterization is a diagnostic procedure that provides the physician with information about the functioning of the heart that is helpful in determining the proper course of treatment. A PTCA, also known as a balloon angioplasty, is a procedure in which a balloon-tipped catheter is inserted into a clogged artery, then inflated to force the artery to widen. PTCAs are less invasive and less expensive than bypass surgery, but are not always effective in the long term.²¹ A CABG, or bypass surgery, involves using a vein to circumvent a clogged portion of an artery. The appropriateness of these procedures depends on the condition of an individual

²¹ The arteries of about 25 to 30% of patients receiving PTCAs will renarrow within 6 months of the procedure, forcing them to undergo another PTCA or bypass surgery. In addition, immediate complications arise for 1 to 3% of PTCA recipients.

patient.²² Wide regional variations in AMI treatment choice, as found in Pilote (1995) and O'Connor (1999), suggest that physicians exercise considerable discretion in determining the course of treatment for AMI patients. As shown in Table 1.5, catheterization rates more than tripled over the study period, while PTCA/CABG rates more than quintupled.

Log 90-day payments (or "expenditures") are the log of the total payments for the patient's inpatient care in the 90 days following the patient's index admission, in 1993 dollars.²³ Total payments include Medicare reimbursement to the hospital, as well as payments made by or on behalf of the patients themselves in the form of deductibles or copayments. The average 90-day expenditure in the sample was about \$13,500. The amount of this expenditure is determined by a number of factors, including the patient's diagnosis, treatment, and readmissions, as well as whether the patient was transferred. Medicare makes a fixed payment to a hospital for each Medicare patient admission, on the basis of the patient's diagnosis-related group (DRG). DRGs are functions of not only the patient's diagnosis, but also medical and surgical procedures, complications and comorbidities, and the patient's status at discharge (e.g., whether the patient has died). Medicare calculates DRG-based payments using annually revised formulas that multiply a DRG weight (based on relative resource use)²⁴ and a standardized dollar amount and adds payments for unusually costly cases. The payment formula takes into account various hospital characteristics, including case mix, local wage rates, a disproportionate

²² Documents at <http://www.americanheart.org/Scientific/statements/1996/1015.html> and http://www.americanheart.org/Heart_and_Stroke_A_Z_Guide/angiop.html were helpful in assembling these descriptions.

²³ A small number of observations with negative or zero dollar amounts were excluded from the payment analysis.

²⁴ In federal fiscal year 1994, for example, coronary bypass with cardiac catheterization had a DRG weight of 5.6791, while percutaneous cardiovascular procedures had a DRG weight of 1.9736.

share of low-income patients, and the provision of medical education (see Latta & Helbing (1991) or <http://www.hcfa.gov/medicare/ippsover.htm> for more information). Medicare's payment formulas mean that the log 90-day payment variable is ultimately a measure of both average treatment cost and treatment intensity. While the log 90-day payment variable will closely track the Medicare program's expenditures on behalf of the patient, it does not necessarily reflect the hospital's actual cost of treating the individual patient.

Log 90-day payments can also reflect a hospital's decision to transfer a patient. This is because Medicare pays twice for transferred patients. Buczko (1993) notes that under Medicare's prospective payment system, hospitals that ultimately transfer a patient receive a per diem payment based on the average cost and length of stay for the DRG assigned to the initial stay. Hospitals accepting a transfer receive the full DRG payment for the patient. This means that payments on behalf of transferred patients are likely to be higher than for similar patients who were not transferred. The result is that the log 90-day payment variable reflects not only the patient's AMI diagnosis, but also the patient's transfers, treatments, and readmissions. Table 1.5 shows that in constant-dollar terms log Medicare expenditures rose over the study period; mean expenditures increased by over \$6,700.

The final dependent variable, 90-day mortality, is intended to provide a measure of patient outcomes. The text of the paper also occasionally reports a few other measures of patient outcomes, such as cardiac readmissions for AMI, congestive heart failure, or ischemic heart disease within one year. Unfortunately, more detailed information on

patients' post-AMI quality of life is not available. Table 1.5 shows that death rates declined steadily until the mid-90s, when the trend flattened out.

Table 1.5 also compares the means of these dependent variables across hospital size and system type. As might be expected, small hospitals are far more likely to transfer their patients than bigger hospitals. In addition, patients initially admitted to small hospitals are less likely to receive catheterizations and PTCA/CABGs, and are more likely to die within 90 days. There are several possible explanations for the differences in treatment intensity and outcomes. One is that staff physicians at the different types of hospital recommend different types of treatment. Another is that AMI patients (or their physicians) who anticipate being helped by the facilities available at a big hospital (i.e., those who could be benefited by catheterization, angioplasty or bypass surgery) tend to go to big hospitals immediately. A third is that while no conscious choice is made about the type of hospital to which a patient is admitted, more severely ill patients who cannot benefit much from more intensive procedures just happen to be more likely to go to small hospitals (a pattern that might result if the most elderly patients live in communities with smaller hospitals). Ultimately, however, because hospital size is a regressor, the regressions will control for its effect on treatment.

Table 1.5
Means of Dependent Variables by Initial Admission Hospital Bed Size and System Type

	Number of Patients	% Transferred	% With Catheter Within 90 Days	% With PTCA or CABG Within 90 Days	Log 90-Day Payments	% 90-Day Mortality
1985	186,654	4.6	13.7	7.5	9.01	31.0
1990	177,239	10.8	32.8	21.1	9.13	27.4
1994	195,115	16.3	45.9	32.0	9.29	24.1
1998	173,261	15.4	50.6	37.8	9.47	24.2
All Years Combined:						
Under 100 Beds						
Local	146,285	21.4	29.6	20.0	9.12	29.3
Local+Big	81,376	24.6	32.7	22.3	9.16	28.6
Nonlocal	55,848	21.8	28.9	19.7	9.10	29.4
Independent	275,066	20.8	26.6	18.1	9.07	28.3
100-250 Beds						
Local	256,212	11.0	41.5	28.8	9.26	26.4
Local+Big	191,161	14.8	39.7	26.5	9.28	26.7
Nonlocal	93,271	9.2	39.7	26.3	9.20	27.1
Independent	601,686	14.2	32.6	21.3	9.20	27.0
Over 250 Beds						
Local	260,423	2.5	49.2	34.4	9.31	24.7
Local+Big	127,492	5.0	42.9	28.9	9.35	25.8
Nonlocal	73,201	2.6	45.0	29.9	9.23	25.2
Independent	427,737	6.5	36.5	24.0	9.30	26.0

1.3 Does Multihospital System Membership Affect the Treatment of Patients?

At the core of this study is a simple question: Do patients of hospitals that are multihospital system members tend to experience different transfer rates, treatment rates, expenditures, and mortality rates than patients of otherwise similar independent hospitals? I use an ordinary-least squares regression to answer this question. An observation is a Medicare patient initially admitted to a study hospital between 1985 and 1998 with a primary diagnosis of AMI. The observation contains the characteristics, treatments, and outcomes Y_{it} of a patient i initially admitted to a hospital j in year t , as well as the characteristics associated with hospital j . Note that the patient need not actually have received treatment at hospital j . (The research question is not how hospital j treats its patients, but whether the system affiliation of hospital j has any effect on how

the patient is treated, *wherever* the patient is ultimately treated.) The regression is of the form:

$$Y_{ijt} = \text{System Types} * \alpha_{it} + \text{Hospital Traits} * \beta_{jt} + \text{Patient Traits} * \gamma_{it} + \text{Hospital Fixed Effects} * \delta_j + \text{Year Fixed Effects} * \chi_t + \varepsilon_{ijt}$$

In other words, the dependent variables described in Section 1.2.4 are regressed on vectors containing indicator variables for the system types described in Section 1.2.2, the hospital characteristics described in Section 1.2.1, the patient characteristics described in Section 1.2.3, hospital fixed effects, and year fixed effects. The hospital characteristics vector includes indicator variables for hospital size interacted with three time periods (1985-89, 1990-94, and 1995-98), which allows for variation in the impact of being a small or medium-sized hospital over time. It also includes for-profit, teaching, contract management, and religious affiliation status. The patient characteristics (sex, age category, and race (black or non-black)) are fully interacted with one another. The table in Appendix 1.A shows all independent variables used in the basic regression except for demographic interaction terms and hospital fixed effects.

The inclusion of year and hospital fixed effects addresses several methodological problems that would otherwise exist. As Table 1.5 shows, procedure rates have increased greatly over time, while mortality rates have decreased. Both trends are probably due to general technological advances in the treatment of AMI. In a regression without time fixed effects, if a particular system type were formed primarily in later years, it may appear to have had a much more positive effect on outcomes than it in reality had. The inclusion of year fixed effects in the regression removes the impacts of time trends, and therefore helps to prevent any misleading results they may produce.

Similarly, the inclusion of hospital fixed effects controls for unchanging characteristics associated with a hospital or with a hospital's market area. If these characteristics directly affect both the dependent variables and the probability that the hospital joins a system, failing to include them in the regression could produce misleading results. For example, if systems enter markets with high demand for hospital care, and high demand is correlated with the (unobservable) severity of illness of the population, regression results without hospital fixed effects may show a correlation between system membership and adverse outcomes. If hospital fixed effects were included in the regression, they would pick up the impact of having a less healthy population, allowing the system variable to pick up the independent impact of being in a system. Including hospital fixed effects thus facilitates interpretation of the results.

Table 1.6 contains the OLS coefficient estimates for two separate regression models. In the first model, the vector of system indicator variables contains only one variable: system membership. In other words, the first model does not distinguish among the many types of systems discussed in Section 1.2.2. In the second model, the system indicator variable vector expands to contain two mutually exclusive system categories: local system membership and nonlocal system membership. The two models use the same dependent variables (listed across the top of Table 1.6), and include the same independent variables (hospital fixed effects, year fixed effects, hospital size categories interacted with time period, other hospital characteristics, and patient demographic variables). The coefficient estimates in Table 1.6 are reported in terms of percentage points, as are the coefficients in all subsequent tables. They show whether relative to independent hospitals with otherwise similar characteristics, hospitals of the

indicated system type are associated with a higher or lower value of the dependent variable.

Table 1.6
The Effect of System Membership on
AMI Patient Treatments, Payments, and Outcomes, 1985-98

	Indep. Variable: System Status	Transferred	Catheter Within 90 Days	PTCA or CABG Within 90 Days	Log 90-Day Payments	90-Day Mortality
Model 1	System	-.37 ^a (.08)	.17 (.11)	.28 ^a (.11)	.64 ^a (.18)	-.09 (.12)
Model 2	Local	-.43 ^a (.08)	.11 (.12)	.20 (.11)	.48 ^a (.18)	-.08 (.12)
	Nonlocal	.12 (.14)	.58 ^a (.20)	.86 ^a (.19)	1.81 ^a (.30)	-.21 (.21)

Notes: Coefficients and robust standard errors (in parentheses) are reported in percentage points. In addition to these system membership variables, the regressions include hospital fixed effects, year fixed effects, hospital bed size interacted with time period, other hospital traits, and patient demographics.

^a Significant at $p < .01$ level.

^b Significant at $p < .05$ level.

The first model in Table 1.6 indicates that as a general matter, patients initially admitted to system hospitals are slightly less likely to be transferred and slightly more likely to receive a PTCA or CABG than patients initially admitted to otherwise similar independent hospitals. At the same time, Medicare expenditures for system patients are more than half a percentage point higher than for patients initially admitted to independent hospitals. Of the Table 1.1 hypotheses, these results are most consistent with the service proliferation hypothesis. The results for the second model in Table 1.6 complicate this interpretation, however. While results for local system hospitals are similar to the results for system hospitals overall, and still match most closely the service proliferation hypothesis, the statistically significant difference in procedure rates disappears. Moreover, patients of nonlocal system hospitals are not less likely to be transferred, but are .6% more likely to received catheterizations, .9% more likely to

receive PTCAs or CABGs, and incur 1.8% higher expenditures than patients initially admitted to independent hospitals. This pattern is most consistent with the information and coordination hypothesis.

All subsequent analyses will use the nine system types described in Section 1.2.2. The regressions reported in Table 1.7 replicate those reported in Table 1.6, but use the more detailed system type definitions. Dependent variables are listed across the top, and the nine system types down the side. The results are mixed. Patients of system hospitals are sometimes more likely to be transferred than patients of independent hospitals, and sometimes less likely. Patients initially admitted to small local system hospitals are about half a percentage point less likely to receive catheterizations than patients initially admitted to small independent hospitals. On the other hand, to the extent there are statistically significant differences, patients of medium and especially big system hospitals are more likely to get catheterizations, PTCAs, or CABGs. System status tends to decrease expenditures for patients initially admitted to small hospitals, while increasing expenditures for patients initially admitted to medium or big hospitals -- unless the admission hospital has no nearby big system partner, in which case there is no statistically significant effect. Finally, the only statistically significant impacts on 90-day mortality are negative impacts for big nonlocal system hospitals.²⁵ In results not reported in this chapter, this mortality result appears to persist through a one-year period, although its statistical significance level drops to $p < .06$; in addition, the positive coefficient on

²⁵ Ermann & Gabel (1986) and Shortell (1988) note that previous studies found essentially no differences in mortality rates or patient care outcomes in system hospitals relative to independent hospitals. Gaumer (1986), using 1974-81 data for selected surgical admissions, finds that for investor-owned hospitals, being in a system is weakly associated with higher in-hospital mortality but lower 180-day mortality, and concludes that there is no pattern of large ownership differences for serious patient outcomes. Shortell & Hughes (1988), using 1983 and 1984 Medicare data for 16 clinical conditions, find

mortality for small nonlocal system hospitals becomes statistically significant at the $p < .02$ level. See Appendix 1.A for more detailed regression results for the "basic" set of regressions displayed in Table 1.7.

Table 1.7
Basic OLS Regression Results: The Effect of System Membership on
AMI Patient Treatments, Payments, and Outcomes, 1985-98

Hospital Size	Indep. Variable: System Status	Transferred	Catheter Within 90 Days	PTCA or CABG Within 90 Days	Log 90-Day Payments	90-Day Mortality
Small	Local	-1.00 ^a (.21)	-.52 ^b (.23)	-.18 (.21)	-.68 (.38)	.08 (.25)
	Local+Big	.17 (.25)	-.44 (.27)	-.14 (.25)	-1.01 ^b (.43)	.13 (.29)
	Nonlocal	-.41 (.30)	-.43 (.33)	.07 (.30)	-1.79 ^a (.52)	.63 (.36)
Medium	Local	-1.26 ^a (.13)	-.26 (.17)	.46 ^a (.16)	-.02 (.27)	-.27 (.18)
	Local+Big	.41 ^a (.15)	-.16 (.19)	-.05 (.18)	1.21 ^a (.30)	-.22 (.20)
	Nonlocal	-.36 ^b (.18)	.35 (.26)	.73 ^a (.24)	1.70 ^a (.40)	-.36 (.27)
Big	Local	-.14 (.09)	.88 ^a (.18)	.66 ^a (.18)	.48 (.28)	.03 (.18)
	Local+Big	-.44 ^a (.12)	.47 ^b (.22)	-.28 (.21)	2.32 ^a (.33)	-.04 (.21)
	Nonlocal	.84 ^a (.15)	1.60 ^a (.32)	1.92 ^a (.31)	4.54 ^a (.48)	-.77 ^b (.32)

Notes: Coefficients and robust standard errors (in parentheses) reported in percentage points. In addition to these system membership variables, the regression includes hospital fixed effects, year fixed effects, hospital bed size interacted with time period, other hospital characteristics, and patient demographics. See Appendix 1.A.

^a Significant at $p < .01$ level.

^b Significant at $p < .05$ level.

What do these results say about the hypotheses concerning the effects of system membership on patient treatment? The message is unclear. The higher transfer rates, procedure rates and payments of big nonlocal system hospitals suggest that the information and coordination hypothesis might apply. But the lower transfer rates and

no statistically significant association between mortality rates among inpatients and affiliation with a

higher procedure rates of mid-sized local and nonlocal system hospitals, and big local system hospitals with big partners, relative to otherwise similar independent hospitals, imply that the proliferation hypothesis (that systems encourage more widespread offerings of cardiac services) is at work.

Several of the results reproduced in Table 1.7 are not consistent with any of the hypotheses listed in Table 1.1. For example, why are patients of big local system hospitals significantly more likely to receive procedures than patients initially admitted to independent hospitals, but equally likely to be transferred? And why are patients initially admitted to mid-sized local system hospitals with big partners more likely to be transferred, if they do not also receive more procedures than patients initially admitted to independent hospitals? While the mixed results may simply imply that multiple hypotheses hold among different system types to differing extents, they may also reflect a model that is not sufficiently precise. In this case, the regression could be constructed in a more informative way.

While the Table 1.7 basic regression includes year fixed effects, it constrains the impacts of systems to be constant across time. As the nature of health care and health care markets have changed over time, it is possible that some of the effects of system membership have also changed. If the impacts of systems have changed, the coefficient estimates in Table 1.7 may be misleading; differing effects of systems in different periods might cancel each other out. The regressions shown in Table 1.8 are of the same form as those in Table 1.7, except that they interact the system variables with two time periods.

multihospital system.

Table 1.8
OLS Regression Results
The Effect of System Membership on AMI Patient Treatments, Payments, and Mortality
In Early (1985-91) and Late (1992-98) Periods

in Early (1985-91) and Late (1992-98) Periods											
		Transferred		Catheter Within 90 Days		PTCA/CABG Within 90 Days		Log 90-Day Payments		90 Day Mortality	
Variables	Years	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Small											
Local	85-91	-.74 ^a	.26	-.35	.28	-.15	.24	.69	.45	.13	.32
	92-98	-.75 ^a	.24	-.52 ^b	.26	-.30	.24	-.70	.42	.03	.28
Loc+Big	85-91	-.85 ^b	.33	-.58	.35	-.21	.31	.17	.58	.22	.40
	92-98	.83 ^a	.28	-.33	.30	-.16	.28	-1.09 ^b	.48	.04	.31
Nonlocal	85-91	.10	.35	-.46	.37	-.13	.33	-.11	.60	.71	.43
	92-98	-.35	.37	-.31	.40	.13	.37	-2.30 ^a	.62	.58	.42
Medium											
Local	85-91	.85 ^a	.16	.41	.21	.08	.20	3.83 ^a	.33	-.25	.23
	92-98	-2.48 ^a	.14	-.66 ^a	.20	.68 ^a	.19	-2.32 ^a	.30	-.32	.19
Loc+Big	85-91	1.67 ^a	.18	.10	.24	-.40	.22	4.32 ^a	.38	-.60 ^b	.26
	92-98	-.47 ^a	.16	-.35	.22	.20	.20	-.77 ^b	.34	-.06	.21
Nonlocal	85-91	1.69 ^a	.20	.26	.29	.12	.27	4.70 ^a	.44	-.22	.30
	92-98	-2.78 ^a	.22	.58	.33	1.50 ^a	.32	-1.67 ^a	.50	-.58	.33
Big											
Local	85-91	2.16 ^a	.10	.93 ^a	.21	.02	.20	3.22 ^a	.32	-.08	.21
	92-98	-3.00 ^a	.10	.78 ^a	.22	1.45 ^a	.21	-3.35 ^a	.33	.05	.21
Loc+Big	85-91	.36 ^b	.14	.22	.26	-.51 ^b	.24	4.70 ^a	.41	-.29	.27
	92-98	-2.10 ^a	.14	.60 ^b	.26	.18	.26	-1.16 ^a	.40	.13	.25
Nonlocal	85-91	1.95 ^a	.16	1.78 ^a	.34	1.62 ^a	.32	6.90 ^a	.51	-.46	.34
	92-98	-2.67 ^a	.17	1.30 ^a	.41	2.93 ^a	.41	-1.75 ^a	.61	-1.55 ^a	.39

Notes: Coefficients and robust standard errors reported in percentage points. The models also include all the variables listed in the previous tables.

^a Significant at p<.01 level.

^b Significant at p<.05 level.

The results reveal patterns that were not visible in the Table 1.7 regressions. The most striking results are for expenditures. For every medium and big system hospital, system membership is associated with payments that range from about three to seven percentage points higher than those of their independent counterparts in the 1985 through 1991 period. In the 1992 through 1998 period, however, Medicare expenditures for system patients were lower than payments for independent patients. One hypothesis for this phenomenon is that during the 1990s, system growth was associated with managed

care growth, and that the growth of managed care changed treatment practices in such a way that all medical expenditures, including Medicare expenditures, were lower. This and other potential endogeneity problems are discussed later in the paper. This explanation is less than satisfying, however, given that more expensive treatments such as catheterizations and especially angioplasties tended to be more common among patients initially admitted to system hospitals.

A second hypothesis is suggested by the other prominent trend in Table 1.8: for medium and big system hospitals, transfer rates were higher than independent hospitals during the early period, but lower in the late period. In other words, the transfer and log 90-day payment patterns are identical. To test the hypothesis that transfer rates contribute to the payment results, I ran two regressions of the same form as the one in Table 1.8, separating transferred patients from non-transferred patients. If the expenditure results were driven solely by the admission hospitals' tendency to transfer (i.e., by the fact that system hospitals admitted more or fewer patients who were eventually transferred), then neither regression should show statistically significant results. But regressions for transferred patients showed some of the same patterns visible in Table 1.8; in the early period, for example, each of the statistically significant results remained, although in a diminished magnitude. In other words, in 1985-91, system hospitals' tendency to transfer may have contributed to the higher Medicare expenditures, but it was not entirely responsible for them.

In the late period, the patterns exhibited by the non-transferred patients diverged from the Table 1.8 patterns. Of the eight statistically significant negative coefficients on expenditures in the late period in Table 1.8, only one remained. In fact, the coefficient

for midsized nonlocal system hospitals became statistically significant and positive. While this might suggest that system hospitals' lower propensity to transfer was responsible for generating the negative coefficient estimates in the Table 1.8 regression, the explanation is not quite that simple. For patients that were transferred, coefficients for six of the eight statistically significant coefficient estimates in Table 1.8 remained negative, and of those, three (those associated with the midsized hospitals) remained statistically significant. In other words, the negative coefficients in Table 1.8 seem in part to be due to the lower expenditures associated with the patients that systems did transfer.²⁶

Table 1.8 provides considerable evidence for service proliferation among system hospitals in the 1992 through 1998 period. Patients of all six types of medium and big system hospitals were less likely to be transferred than patients of independent hospitals, and in five of the six cases, this result was associated with higher procedure rates. This pattern is consistent with the theories that system hospitals are more likely to provide services, and that patients of hospitals that provide services are more likely to receive them. On the other hand, in the 1985-1991 period, patients of medium and big system hospitals tended to be more likely to be transferred and incurred higher expenditures, but showed no consistent pattern in procedure rates. Perhaps some combination of the information/coordination hypothesis and the consolidation hypothesis was at work in the early period.

²⁶ In addition, in a regression of log 90-day payments on indicator variables for transfers, catheterizations, PTCA/CABG, second AMI admissions, and death within 90 days, in addition to the same set of independent variables used in the Table 1.8 regressions, the system status coefficients did not change much. Higher transfer rates did substantially contribute to expenditures (more than catheterizations, but not as much as PTCAs/CABGs or second AMIs), but did not eliminate the effect of system status.

In general, mixed results could have a number of explanations. First, they may result from multiple system effects interacting. If both the consolidation and information hypotheses hold, for example, we would expect to see an increase in transfers but unclear effects on all of the other variables. Second, individual parts of the multi-part hypotheses may not hold; for example, perhaps the fact that a hospital provides services itself simply has no effect on procedure rates. Third, the estimation may suffer from the endogeneity problems discussed in Section 1.6. But given the large effects that systems appear to have on transfers and payments, it is worth taking a closer look at hospitals' provision of cardiac services.

1.4 Does System Membership Affect the Provision of Cardiac Services?

The hypothesis that system membership is associated with service consolidation can be tested directly through an investigation of whether system hospitals are more likely to have in-hospital facilities for performing catheterizations, PTCAs, and CABGs. I use Medicare procedure rates to determine whether hospitals provide these services.²⁷ Table 1.9 shows the prevalence of catheterization and angioplasty services among system and independent hospitals, stratified by size.²⁸ It demonstrates that system hospitals are more likely to offer catheterization and angioplasty services than independent hospitals, consistent with the hypothesis that system membership is associated with the proliferation of service offerings. At the same time, there is some support for the

²⁷ The AHA Survey contains data on facilities, but it does not document angioplasty services prior to 1989, and the nonresponse rate exceeds 10% for some years. I have therefore applied a gap-filling methodology to Medicare claims data to determine whether a hospital offers a particular service. The correspondence between the resulting coding and AHA-based coding (when present) is generally more than 90% for the three types of cardiac services, reaching 99% for bypass surgery.

²⁸ Bypass surgery services are not shown, but there is a high degree of correlation between these services and angioplasty services. Because bypass surgery may be needed if complications arise during a PTCA, hospitals generally offer both services together.

consolidation hypothesis as well, in that hospitals with big local partners were less likely to offer angioplasty services than local system hospitals without big partners:

Table 1.9
% of Hospitals Offering Cardiac Services, by Size, System Status, and Year

	Catheterization Services				Angioplasty Services			
	1985	1990	1994	1998	1985	1990	1994	1998
Under 100 Beds								
Local	4.5	10.9	20.2	22.7	0.0	1.4	4.6	5.3
Local+Big	5.6	15.3	27.9	27.7	0.0	1.6	3.5	4.6
Nonlocal	3.4	12.6	24.2	27.6	0.0	0.4	3.4	3.2
Independent	1.4	6.3	13.4	14.4	0.0	0.4	1.6	2.1
100-250 Beds								
Local	41.4	66.7	80.6	83.3	10.9	27.7	46.0	53.9
Local+Big	34.1	71.0	80.4	79.7	7.5	22.7	35.6	43.4
Nonlocal	40.9	75.4	83.9	88.5	12.8	31.7	41.9	60.7
Independent	26.7	54.2	67.0	78.1	5.9	18.3	26.2	35.1
Over 250 Beds								
Local	89.4	98.6	99.3	97.1	56.8	83.9	92.0	90.7
Local+Big	78.7	93.1	95.3	96.9	38.0	63.9	76.6	83.5
Nonlocal	85.3	93.9	97.0	100.0	50.0	79.6	93.9	93.8
Independent	72.2	85.1	88.3	93.6	38.9	62.7	63.4	67.7

But these descriptive statistics cannot answer the question about whether system membership motivates service offering decisions. The statistics do not control for factors other than system membership that may be associated with the provision of high-tech cardiac services. To control for these other factors, I constructed regressions in which an observation was a hospital-year, and the dependent variable (Y_{jt}) was either the provision of catheterization services or the provision of angioplasty services. The explanatory variables were indicators for system membership interacted with two time periods, hospital characteristics (hospital bed size interacted with three time periods, for-profit status, religious status, contract managed status, and teaching status), hospital fixed effects, and year fixed effects. The regression was therefore of the form:

$$Y_{jt} = \text{Vector of System Types} * \alpha_{jt} + \text{Vector of Hospital Characteristics} * \beta_{jt} + \text{Hospital Fixed Effects} * \delta_j + \text{Year Fixed Effects} * \chi_t + \epsilon_{jt}$$

The results indicated that the correlation between system status and treatments and expenditures may indeed be related to service offerings:

Table 1.10
OLS Regression of Cardiac Service Offerings on System Status
in Early (1985-91) and Late (1992-98) Periods

Variables	Years	Catheterization Services		Angioplasty Services		Transferred (from Table 1.8)	
		Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Small							
Local	85-91	.65	.63	.10	.29	-.74 ^a	.26
	92-98	1.19 ^c	.62	.59 ^c	.32	-.75 ^a	.24
Loc+Big	85-91	1.48 ^c	.89	-.07	.37	-.85 ^a	.33
	92-98	1.23	.84	.40	.39	.83 ^a	.28
Nonlocal	85-91	.08	.88	-.26	.35	.10	.35
	92-98	1.03	1.01	.17	.46	-.35	.37
Medium							
Local	85-91	2.44 ^a	.96	-1.63 ^b	.76	.85 ^a	.16
	92-98	-.60	.86	1.76 ^b	.74	-2.48 ^a	.14
Loc+Big	85-91	-.10	1.16	-1.42 ^c	.83	1.67 ^a	.18
	92-98	-2.41 ^b	.98	2.18 ^a	.78	-.47 ^a	.16
Nonlocal	85-91	1.96	1.32	-.43	.72	1.69 ^a	.20
	92-98	-.33	1.42	3.10 ^a	1.15	-2.78 ^a	.22
Big							
Local	85-91	4.88 ^a	.90	-.35	1.23	2.16 ^a	.10
	92-98	-3.04 ^a	.82	1.68	1.05	-3.00 ^a	.10
Loc+Big	85-91	-.43	1.38	-1.82	1.48	.36 ^b	.14
	92-98	-1.52	1.25	2.17 ^c	1.23	-2.10 ^a	.14
Nonlocal	85-91	1.03	1.63	3.56 ^c	1.87	1.95 ^a	.16
	92-98	-4.21 ^a	1.31	4.41 ^b	1.90	-2.67 ^a	.17
Mean							
	85-91	34.95		16.23		8.54	
	92-98	47.10		23.48		15.56	

Coefficients and robust standard errors are reported in percentage points.

N=49,512 for hospital provision-of-service analyses.

^a Significant at p<.01 level; ^b Significant at p<.05 level; ^c Significant at p<.10 level.

Table 1.10 reveals several interesting patterns. One is that during the late period, several types of system hospital were simultaneously less likely to provide catheterization services and more likely to provide angioplasty services. A separate regression provides the likely reason for this disparity: Independent hospitals were much more likely than these types of system hospitals to provide catheterization services without also providing

angioplasty services. In other words, the system hospitals were more likely than independent hospitals to provide no cardiac services whatsoever, while simultaneously being more likely than independent hospitals to provide both cardiac services. This may lend intuitive support for the service proliferation hypothesis; the argument would be that system membership was able to generate sufficient capital or expertise to allow hospitals to take the next step from providing only catheterization services to providing angioplasty services as well. At the same time, however, it may support the consolidation hypothesis, since marginal system hospitals were less likely to offer cardiac services at all.

The other interesting pattern in Table 1.10 is the inverse correlation between the provision of angioplasty services and the likelihood of transfer, particularly for medium and big hospitals (with the exception of big nonlocal system hospitals in the early period). As might be expected, when systems were more likely than independent hospitals to offer angioplasty services, they were less likely to transfer their patients.

1.5 Does System Membership Affect the Choice of Treatment Facility?

The previous analyses have focused on hospitals' service offerings and their resulting overall propensity to transfer their patients. But the transfer *destination* for these patients is also important to examine. Hospitals' willingness to consolidate services will depend in part on their ability to keep revenues within the hospital system. If patients are transferred without regard to the destination hospital's system affiliation, then a system will be less willing to stop providing a service because of a concern that it will lose patients. Using a multinomial logit and California data, I tested whether system affiliations affected patient transfer destinations. Each California local system hospital that actually transferred a patient between 1985 and 1998 to a nonpublic hospital meeting

study inclusion criteria was assumed to have faced a choice set of all (nonpublic) study hospitals within 100 miles. The logit results show that California local system hospitals were more than three times as likely to transfer to system partners than to independent hospitals, controlling for distance between the hospitals, services offered, and other characteristics. Interestingly, system hospitals were nearly 20% less likely to transfer to system hospitals that were not partners than to independent hospitals. Appendix 1.B contains the full results of the logit analysis.

The explanation for Medicare patients' tendency to remain within hospital systems once admitted to a system hospital is not clear. Transferring a patient to a system partner might be easier (i.e. involve fewer transaction costs) if the hospital has already developed a means of sharing information or a specific transfer protocol. In addition, physicians may face lower costs in assessing whether (or ensuring that) the system partner is of adequate quality, and therefore may be more likely to send patients there. Or perhaps physicians hold staff privileges at all of the hospitals in the system, and choose to refer to hospitals at which they hold privileges.²⁹ Ultimately, however, the most important question concerns not whether system hospital patients are transferred to affiliated hospitals, but the ability of the affiliated hospitals to provide patients with appropriate, high-quality care.

As discussed previously, several studies have found a positive association between procedure volumes and patient outcomes. One way to develop a better understanding of the effect of multihospital system membership on patients is to examine the procedure volumes of the hospitals at which patients are eventually treated. If the

consolidation hypothesis were true, for example, then a patient initially admitted to a system hospital might be transferred to a high-volume system partner, while an independent hospital patient remained at his or her admission hospital, even if it provided fewer procedures. On the other hand, if the service proliferation hypothesis were true, patients initially admitted to system hospitals might receive treatment at lower-volume facilities than patients initially admitted to independent hospitals.

As an initial evaluation of hospital procedure volume, I calculated a patient-weighted average procedure volume for each type of admission hospital. For each patient initially admitted to a small local system hospital, for example, I tracked if and where the patient received a PTCA. For patients who did receive a PTCA, I calculated the total number of PTCAs performed on Medicare patients in their treatment year by their treatment hospital (as opposed to their initial admission hospital). I then averaged this total-PTCA number across all PTCA patients initially admitted to small local system hospitals.

I found that overall, patients initially admitted to big system hospitals tended to receive treatment at higher-volume facilities than patients of any other size system hospitals or any size independent hospital. Patients initially admitted to big hospitals with smaller system partners were treated at the highest-volume facilities, with the median patient treated at a facility performing 191 Medicare PTCAs in a single year in the 1985-91 period, and 573 PTCAs in the 1992-98 period. Patients initially admitted to midsized hospitals, whether system hospitals or independent, tended to be treated at the lowest-volume facilities. In the early study period, the median patient admitted to a

²⁹ Alternatively, hospitals may choose to affiliate with hospitals with which they have already established a transfer relationship, making it appear that system affiliations influence transfers when in fact

medium local system hospital was treated at a facility performing 129 PTCAs; in the late study period, the median patient admitted to a medium nonlocal system hospital was treated at a facility performing 273 PTCAs. This pattern could result from big hospitals treating their patients at their own high-volume facilities, while small hospitals refer their patients to high-volume facilities, and medium hospitals retain patients in their own lower-volume facilities. Finally, patients of small system hospitals with big partners and patients of small independent hospitals tend to be treated at higher volume facilities than patients of small system hospitals without big partners.

But these descriptive statistics cannot answer questions about the effects of system status, since many other factors may influence the PTCA volume of (or the choice of) treatment hospitals. To control for these other factors, I used another ordinary least squares regression analysis. While this analysis for the most part follows the previous patient-based regression model, it includes only those patients who received PTCAs. For each PTCA-receiving patient i , I constructed indicator variables Y_{ijt} indicating whether the hospital at which the patient received his or her PTCA performed more than 100 or more than 250 PTCAs on Medicare patients in the patient's admission year t . In two separate regressions, I then regressed these variables on the patient's initial admission hospital j system status, admission hospital fixed effects, year fixed effects, and other admission hospital characteristics (the same independent variables used in previous regressions). In other words, the regression model is essentially testing how the admission hospital's system status is associated with the decision to send a patient to a

the reverse is true. Endogeneity questions are discussed in Section 1.6.

high- or low-volume treatment hospital.³⁰ I also regressed two outcome variables for the PTCA recipients, 90-day mortality and 1-year cardiac readmission, on the same independent variables. The results are reported in Table 1.11.

Table 1.11
OLS Regression of PTCA Patient Treatment Hospital Volume and
PTCA Patient Outcomes on System Status
in Early (1985-91) and Late (1992-98) Periods

Initial Admission Hospital System Status	Years	PTCA Patient's Treatment Hospital Performed >100 Medicare PTCAs In Year		PTCA Patient's Treatment Hospital Performed > 250 Medicare PTCAs in Year		PTCA Patient's 90-Day Mortality		PTCA Patient Had Cardiac Readmission Within 1 Year	
		Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Small									
Local	85-91	-1.16	.92	2.35 ^b	1.04	-.70	.70	-1.03	1.30
	92-98	-1.09	.58	-2.13 ^a	.72	.16	.52	.23	.93
Loc+Big	85-91	1.73	1.18	-.22	1.37	-1.35	.86	2.42	1.70
	92-98	-2.83 ^a	.61	-4.41 ^a	.79	-.25	.57	-.22	1.00
Nonlocal	85-91	.66	1.21	3.45 ^b	1.39	-.62	.91	-.15	1.71
	92-98	1.67 ^b	.82	.62	1.03	-.99	.75	-.15	1.32
Medium									
Local	85-91	-.82	.57	5.41 ^a	.59	.33	.46	-1.24	.76
	92-98	.05	.34	-.28	.40	-.51	.33	.71	.53
Loc+Big	85-91	-.16	.72	1.81 ^b	.73	-.54	.52	-.64	.92
	92-98	.20	.39	-3.42 ^a	.47	-.60	.36	.88	.61
Nonlocal	85-91	-1.07	.69	-1.72 ^b	.68	.52	.59	-2.40 ^a	.92
	92-98	2.75 ^a	.53	.54	.63	.78	.54	.38	.83
Big									
Local	85-91	1.42 ^a	.42	-.20	.45	.39	.40	-2.15 ^a	.62
	92-98	-2.85 ^a	.25	-1.85 ^a	.36	.29	.34	.38	.52
Loc+Big	85-91	6.79 ^a	.58	-.19	.67	.19	.54	-.90	.89
	92-98	1.14 ^a	.28	.00	.43	.18	.40	-.29	.64
Nonlocal	85-91	5.60 ^a	.60	-.42	.71	.49	.60	-1.49	.95
	92-98	2.46 ^a	.46	4.20 ^a	.60	-.58	.61	-1.34	.94
Mean	85-91	71.39		28.85		8.34		31.62	
	92-98	93.24		68.70		8.51		27.77	

Coefficients and robust standard errors are reported in percentage points. N=342,173.

^a Significant at p<.01 level.

^b Significant at p<.05 level.

³⁰ While the physician and patient together choose the patient's treatment hospital, the hypothesis is that the system status of a hospital ultimately influences their decision. If, for example, the initial admission hospital offers angioplasties (a decision that this study shows to be correlated with system status), then the patient will be less likely to be transferred to receive an angioplasty. Whether the patient is

The 100-PTCA threshold was chosen to separate low-volume hospitals from other hospitals, while the 250-PTCA threshold was chosen to separate relatively high-volume hospitals from other hospitals. The extent to which these thresholds correspond to the thresholds used in studies of total patient populations (rather than just Medicare patients) is unclear. Results that were statistically significant using both thresholds were statistically significant in the same direction. The results varied according to both system type and time period involved. In some cases, the results corresponded to the previous PTCA service offering and transfer results. For example, in the 1985-91 period, medium local system hospitals with big partners were less likely than medium independent hospitals to offer PTCA services and more likely to transfer, and their patients were more likely to receive PTCAs at facilities performing more than 250 PTCAs per year. The 1992-98 period showed exactly the opposite pattern; consistent with the service proliferation hypothesis, medium local system hospitals were more likely to offer PTCAs, less likely to transfer, and their patients were more likely to receive PTCAs at facilities performing fewer than 250 PTCAs per year.

In the abstract, it is unclear whether these findings should be cause for concern. First, this pattern characterized only a few system types. Second, it is unclear whether the system hospitals in the study are high- or low-volume overall, since the data include only PTCAs performed on Medicare patients. Third, no studies have examined whether the volume of system partners can help increase the quality of care throughout the system; it may be that while the individual treatment facility provided relatively few PTCAs, the volume of the system as a whole was sufficiently great to ensure quality of

treated at a high- or low-volume facility then depends on whether the patient's initial admission hospital is high- or low-volume.

care. And finally, the results of a regression of PTCA patient outcomes on system status belie the notion that system hospital patients experience worse mortality or readmission rates than independent hospital patients. In fact, there were no statistically significant differences in 90-day mortality rates between PTCA patients of any type of system hospitals and PTCA patients of independent hospitals. In the early study period, patients of midsized nonlocal system hospitals and big local system hospitals experienced lower cardiac readmission rates. In the case of the big system hospitals, this result might be explained in part by the patient's higher likelihood of being treated at a hospital performing more than 100 PTCAs, but the midsized nonlocal system hospital patients were actually less likely to be treated at high volume facilities.

Thus, this study provides little evidence for the hypothesis that multihospital system status is associated with worse outcomes for PTCA patients, despite the proliferation of cardiac services. Previous results showed even more consistently that there is no reason to believe that system status is associated with worse outcomes for heart attack patients in general. Moreover, regression results provide considerable evidence that in recent years, patients initially admitted to system hospitals receive treatment at a significantly lower cost to Medicare. These findings imply that while system status may be associated with changes in the nature of service provision, it is also associated with more efficient treatment of patients -- achieving similar outcomes at lower costs to Medicare.

Why? Admittedly, the proliferation hypothesis cannot fully explain the regression results. For example, small system hospitals do not appear significantly more or less likely to offer angioplasty services than their independent counterparts, and yet

their patients experience differences in transfers, treatments and expenditures relative to independent hospital patients. Moreover, the inclusion of cardiac facility dummies in the Table 1.8 regression does not eliminate the results. Having catheterization and angioplasty services is associated with lower transfer rates, higher procedure rates, higher expenditures in the early period, lower expenditures in the later period, and lower 90-day mortality. Treating service offerings as a hospital characteristic did not substantially change the estimates of the impact of system status on 90-day mortality. For small hospitals, adding the indicator variables altered the transfer estimates in inconsistent ways; strengthened or did not change the catheterization and PTCA/CABG estimates; and made the log 90-day payment estimates follow the same positive-in-early-period negative-in-late-period pattern visible among larger hospitals. For medium and big hospitals, many of the results weakened; in fact, four of the six log 90-day payment coefficients in the late period lost statistical significance. The implication of these results is that the differential level of services that system and independent hospitals provide does affect patient treatment, outcomes, and expenditures, but does not explain entirely the differences in these measures associated with system status.³¹ More investigation of the potential causes of differences between system and nonsystem hospitals is needed.

1.6 Methodological Challenges: Endogeneity

The analysis of the effects of multihospital system membership on the treatment of patients is hampered by the difficulty of disentangling the effects of joining a system from the effects of other hospital or hospital market characteristics. The inclusion of hospital fixed effects in all of the analyses in this study addresses this problem at least in

³¹ Interestingly, for big hospitals, the directions of five of the six transfer estimates actually flipped, so that system hospitals were less likely than independent hospitals to transfer patients in the early

part. As explained previously, the inclusion of fixed effects controls for the average effect of the hospital's (or the hospital market's) characteristics across time. But the inclusion of fixed effects cannot control for all of the endogeneity problems inherent in the study's analyses. Previous studies, including Luke et al. (1995) and Alexander & Morrissey (1988), demonstrate that the selection of hospitals into systems is not random.³² A hospital's desire to search for a potential system partner, and a potential system partner's desire to consider its request, are both likely to be functions of hospital characteristics. There may be some unobserved characteristics not fixed over time that predispose a hospital to joining a system; expectations about changes in the future could be one such characteristic. If any of these characteristics are correlated with the dependent variables, the estimates of the effects of system membership will be biased.

To assess the magnitude of this problem, I performed a regression analysis comparing independent hospitals that would soon join systems to independent hospitals that would not soon join systems. To be included in the analysis, a hospital must show one of four patterns in four consecutive years (beginning in any year, 1985-1995): it could remain independent for all 4 years (nonsystem hospitals), be in a particular system type for all four years (system hospitals), remain independent for two years and then join a system for two years (system joiners), or be in a system for two years, and then become independent for two years (system leavers). An observation is a patient admitted in the first of the four years to a hospital meeting these criteria, and the dependent variables are the patient's outcomes for that admission year. While this approach excludes over 22%

period, but more likely to transfer in the late period.

³² Among other factors, Luke et al. find that the number of competitors is strongly and positively related to local hospital system penetration. Alexander & Morrissey find that a higher percentage of elderly

of observations in the 1985 through 1995 time period, it ensures that the period in which hospitals transition between non-system and system status or switch among system types does not cloud the coefficient estimates. The regression includes the same regressors as the basic regression (listed in Appendix 1.A), except that it includes 27 system regressors (9 for system joiners, 9 for system hospitals, and 9 for system leavers), each interacted with two time periods. The nine variables in each category correspond to the nine system types listed in Table 1.7. The regression is therefore of the form:

$$Y_{it} = \underset{\substack{\text{27 System} \\ \text{Types} \\ \text{*2 Time} \\ \text{Periods}}}{\alpha_{it}} + \underset{\substack{\text{Hospital} \\ \text{Traits}}}{\beta_{it}} + \underset{\substack{\text{Patient} \\ \text{Traits}}}{\gamma_{it}} + \underset{\substack{\text{Hospital} \\ \text{Fixed} \\ \text{Effects}}}{\delta_j}} + \underset{\substack{\text{Year} \\ \text{Fixed} \\ \text{Effects}}}{\chi_t}} + \varepsilon_{it}$$

If there were no endogeneity in the data, there should be no statistically significant difference between coefficients of independent hospitals soon to join systems and independent hospitals that remain independent (the omitted category). Both types of hospitals would be independent during the year of the patient observation, so there should be no "system effect." But if hospitals that eventually joined systems were somehow different from the average independent hospital, some of the coefficients may be statistically significantly different from zero. Appendix 1.C shows the coefficient estimates for hospitals that would soon join systems, and, for comparison, the coefficients for the basic OLS regression for 1985 through 1995.³³

The results suggest that soon-to-be system hospitals do differ from independent hospitals, although not to the extent that pre-existing characteristics explain all the results in Table 1.8. Perhaps the strongest evidence for endogeneity can be found in the

in the population, teaching hospital status, larger hospital size, a higher occupancy rate, and a smaller revenue-to-expenditure ratio all make multihospital system acquisition less likely.

estimates for big local system hospitals with smaller partners. Both the transfer and log 90-day payment effects in Table 1.8 can be seen in big independent hospitals prior to their partnership with smaller hospitals. In the early period, they tended to transfer more and their patients were more expensive, and in the late period, they tended to transfer less and their patients were less expensive than patients of hospitals that would remain independent. Other transfer results that predated the joining of systems include the negative coefficients on transfers in the late period for medium local system hospitals and big nonlocal system hospitals. Both of these results are reinforced by findings (from a separate regression structured in the same way as the Appendix 1.C regression) that these system hospital types were also more likely to offer angioplasty services before they joined systems.

On the other hand, many of the coefficients reported in the Appendix 1.C future-system regression coefficients were statistically insignificant, even where the coefficients were statistically significant in the current-system regression. And others were statistically significant where coefficients in the current-system regression were not, or were statistically significant in the opposite direction. Procedure rates and mortality rates in particular show little evidence that endogeneity was driving the Table 1.8 results. Overall, however, the results of the Appendix 1.C analyses underscore the need for caution in interpreting the earlier results.

Just as hospitals do not self-select into systems in a random way, patients do not necessarily self-select into hospitals in a random way. While many AMI patients will choose the closest hospital because they require immediate treatment, some may choose

³³ This is the same regression as in Appendix 1.A, with observations from years 1996 through 1998 removed.

their initial admission hospital on the basis of a host of other hospital characteristics, including the types of services available at the hospital. If there is some characteristic of system hospitals that attracts a particular type of patient, and the particular type of patient differs systematically from other patients in an unobservable way correlated with one of the dependent variables, the coefficient on system membership will be biased.³⁴ By not explicitly modeling the patient's hospital choice, this paper implicitly assumes that Medicare patients do not self-select into system (as opposed to nonsystem) hospitals on the basis of unobserved health characteristics. To the extent that this assumption is incorrect, the regression results will be misleading. However, in part because many patients are admitted to hospitals for treatment on an emergency basis, I believe that this assumption is reasonable.

1.7 Conclusions

Because multihospital system membership has grown in recent years, it is important to understand how system membership ultimately affects the treatment of patients. The regression analyses in this study suggest, first, that system status is associated with differences in patient treatment. Second, systems' effects on patients appear to vary depending on the size of the patient's initial admission hospital and the nature of the system in which it participates. The effects of systems vary even more depending on the time frame considered; they appear to have changed significantly between the late 1980's and early 1990s.

³⁴ The analysis in Dranove & Shanley (1995) brings to mind one such scenario. More severely ill patients may face higher search costs than healthier patients in finding the best hospital. System hospitals can lower patient search costs, so more severely ill patients may choose system hospitals. If the severity of patient illness is not captured by the demographic regressors in the model, system hospitals may appear to produce poorer outcomes than nonsystem hospitals.

By the early 1990s, mid-sized and big system hospitals tended to transfer their patients less than their otherwise similar independent counterparts. Patients initially admitted to many of these system hospitals in the 1990s were more likely to receive PTCA or CABGs, and yet, for every type of system hospital, were less costly to Medicare than patients initially admitted to independent hospitals. These findings may in part result from the tendency of system hospitals to offer PTCA services themselves, which obviates the need to transfer their patients for treatment. The findings are consistent with the hypothesis that systems can facilitate access to the capital and expertise needed to provide high-tech cardiac services, and therefore permit member hospitals to offer services they might not otherwise have offered. While service proliferation could conceivably lead to worse health outcomes as patients are treated at lower-volume hospitals, there is no evidence to support this conjecture.

The finding of lower treatment expenditures without poorer outcomes suggests that the formation of system affiliations may have had a net beneficial effect on the provision of cardiac care. Potential concerns about the effects of hospital consolidation should be tempered by these results. At the same time, however, the possibility that the regression results are biased due to unresolved endogeneity problems deserves further investigation.

Moreover, it is unclear why the regressions show such a significant distinction between the effects of system status in the late 1980s and the 1990s. At least two trends over this time period may somehow be influencing system effects; the first is the dramatic change in cardiac technologies, and the second is the growth of managed care and cost-control pressures in general. As the results of this study have shown, the cardiac

technology changes are a likely contributor to system effects, but are unlikely to explain system effects fully. This study has not looked at the effects of managed care on systems, or at its independent effects on patient treatments, costs, or outcomes. A more complete understanding of the changes of system effects over time will likely require a more thorough assessment of managed care impacts, and further investigation of what other changes occurred over the study period.

If this paper's regression findings were to survive further investigation, they would suggest that antitrust authorities should be more sanguine about the likely effects of mergers or other hospital affiliations. While affiliations may increase prices, they may ultimately lower Medicare expenditures without harming patient outcomes. But even this policy prescription is not without caveats. First, just as the hospitals' environment changed between the 1980s and the 1990s, it continues to change today. Further decreases in competition through mergers, for example, may mean that future system formation will have different effects from those found for the early 1990s. Or changes in Medicare reimbursement or other technological or management advances may eliminate the effects currently associated with system status. Second, while heart attacks are an important subject of study both because of their prevalence and because of their dramatic health effects, they are certainly not the only condition for which system status may affect treatments, expenditures, or outcomes. Other diseases or conditions are also subject to considerable discretion in treatment, in both acute and nonacute settings. A full evaluation of the net effects of systems on patients will require exploring the effects of systems on patients with a broader, more representative set of diseases. The

methodology and results of this study, however, constitute a first step in the assessment of the effects of multihospital system membership on patients.

APPENDIX 1.A

Regression Results: Effects of Multihospital System Membership on Patients

Variables	Transferred		Catheterization Within 90 Days		PTCA or CABG Within 90 Days		Log 90-Day Payments	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Small Local	-1.00 ^a	.21	-.52 ^a	.23	-.18	.21	-.68	.38
Loc+BigPartner	-.17	.25	-.44	.27	-.14	.25	-1.01 ^b	.43
Nonlocal	-.41	.30	-.43	.33	.07	.30	-1.79 ^a	.52
Medium Local	-1.26 ^a	.13	-.26	.17	.46 ^a	.16	-.02	.27
Loc+BigPartner	.41 ^a	.15	-.16	.19	-.05	.18	1.21 ^a	.30
Nonlocal	-.36 ^b	.18	.35	.26	.73 ^a	.24	1.70 ^a	.40
Big Local	-.14	.09	.88 ^a	.18	.66 ^a	.18	.48	.28
Loc+BigPartner	-.44 ^a	.12	.47 ^b	.22	-.28	.21	2.32 ^a	.33
Nonlocal	.84 ^a	.15	1.60 ^a	.32	1.92 ^a	.31	4.54 ^a	.48
1986	1.54 ^a	.08	4.91 ^a	.12	2.83 ^a	.09	9.21 ^a	.21
1987	3.41 ^a	.08	9.55 ^a	.12	5.58 ^a	.10	10.48 ^a	.21
1988	5.33 ^a	.08	13.62 ^a	.12	8.53 ^a	.10	10.97 ^a	.22
1989	6.03 ^a	.08	14.99 ^a	.13	10.05 ^a	.11	10.87 ^a	.22
1990	3.16 ^a	.09	20.55 ^a	.15	15.07 ^a	.14	11.70 ^a	.26
1991	5.68 ^a	.09	25.75 ^a	.15	18.73 ^a	.14	15.94 ^a	.25
1992	7.31 ^a	.10	29.03 ^a	.15	21.29 ^a	.14	23.33 ^a	.25
1993	7.77 ^a	.10	30.41 ^a	.15	22.94 ^a	.14	25.27 ^a	.26
1994	9.20 ^a	.10	33.45 ^a	.16	25.81 ^a	.15	28.43 ^a	.26
1995	7.80 ^a	.10	35.33 ^a	.17	29.11 ^a	.16	32.67 ^a	.29
1996	7.11 ^a	.10	36.39 ^a	.17	30.33 ^a	.17	39.93 ^a	.29
1997	7.57 ^a	.11	37.97 ^a	.18	31.94 ^a	.17	45.04 ^a	.30
1998	7.55 ^a	.11	39.01 ^a	.18	33.15 ^a	.17	46.81 ^a	.30
Small 1985-89	-6.77 ^a	.21	3.17 ^a	.26	2.35 ^a	.24	-5.42 ^a	.43
1990-94	2.90 ^a	.22	-1.52 ^a	.27	-1.07 ^a	.25	.61	.43
1995-98	7.47 ^a	.22	-1.04 ^a	.29	-2.72 ^a	.27	3.57 ^a	.46
Medium 1985-89	-4.63 ^a	.12	1.06 ^a	.18	.90 ^a	.17	-3.58 ^a	.29
1990-94	1.51 ^a	.12	.21	.19	-.49 ^a	.18	-.73 ^b	.30
1995-98	3.08 ^a	.13	1.12 ^a	.22	-.68 ^a	.21	.62	.34
For Profit	-2.11 ^a	.22	-.79 ^a	.31	.06	.29	-.26	.48
Religious	-.01	.13	-.20	.21	-.64 ^a	.20	.69 ^b	.33
Contract Managed	-.12	.15	-.04	.18	.07	.17	-.15	.29
Teaching	-.08	.09	.04	.17	.28	.16	.55 ^b	.26
Female	-1.00 ^a	.10	-4.44 ^a	.13	-4.78 ^a	.13	-3.67 ^a	.20
Black	-7.09 ^a	.24	-12.36 ^a	.37	-15.90 ^a	.33	-15.63 ^a	.54
Age 70-74	-2.73 ^a	.09	-7.90 ^a	.11	-5.82 ^a	.11	-3.72 ^a	.17
Age 75-79	-7.07 ^a	.09	-19.36 ^a	.12	-14.63 ^a	.11	-10.99 ^a	.18
Age 80-89	-14.55 ^a	.08	-38.66 ^a	.11	-29.04 ^a	.10	-26.11 ^a	.17
Age 90-99	-20.36 ^a	.11	-54.58 ^a	.15	-39.61 ^a	.13	-38.38 ^a	.30
Mean	12.11		36.55		24.59		9.2259	
N	2,589,758		2,589,758		2,589,758		2,581,099	
R-square	.1599		.2497		.1831		.1420	

Notes: Coefficients and robust standard errors reported in percentage points. Categories omitted from the regression are: not in system, 1985, more than 250 beds, nonprofit, nonreligious, not contract managed, nonteaching, male, nonblack, and age 65-69. Coefficient estimates for demographic interaction terms and hospital fixed effects not presented. ^a Significant at p<.01 level; ^b Significant at p<.05 level.

APPENDIX 1.A, continued
Regression Results: Effects of Multihospital System Membership on Patients

		90 Day Mortality		Readmitted with Cardiac Diagnosis Within 1 Year	
Variables		Coef.	S.E.	Coef.	S.E.
<100 Beds	Local	.08	.25	.10	.23
	Loc+BigPartner	.13	.29	-.19	.26
	Nonlocal	.63	.36	-.15	.32
100-250 Beds	Local	-.27	.18	.29	.17
	Loc+BigPartner	-.22	.20	.35	.18
	Nonlocal	-.36	.27	.41	.25
>250 Beds	Local	.03	.18	-.40 ^b	.17
	Loc+BigPartner	-.04	.21	.12	.20
	Nonlocal	-.77 ^b	.32	-.30	.30
1986		.32 ^b	.15	.43 ^a	.14
1987		-.52 ^a	.15	.55 ^a	.14
1988		-1.37 ^a	.15	.24	.14
1989		-2.65 ^a	.15	.09	.14
1990		-3.94 ^a	.17	.69 ^a	.16
1991		-5.58 ^a	.17	.71 ^a	.16
1992		-6.64 ^a	.17	.53 ^a	.16
1993		-6.77 ^a	.17	.09	.16
1994		-7.43 ^a	.17	-.02	.16
1995		-7.35 ^a	.18	.07	.17
1996		-7.32 ^a	.18	.13	.17
1997		-7.65 ^a	.19	-.31	.17
1998		-7.91 ^a	.19	-.36 ^b	.18
<100 Beds	1985-89	.19	.29	-.16	.26
	1990-94	.13	.28	-.85 ^a	.26
	1995-98	-.36	.29	-1.11 ^a	.27
100-250 Beds	1985-89	.43 ^b	.19	-.26	.18
	1990-94	.34	.19	-.67 ^a	.18
	1995-98	-.21	.21	-.87 ^a	.20
For Profit		.48	.32	.04	.29
Religious		-.11	.21	-.14	.20
Contract Managed		-.03	.20	-.18	.18
Teaching		-.39 ^b	.17	.32 ^b	.16
Female		2.45 ^a	.11	2.05 ^a	.12
Black		-.51	.29	.90 ^a	.33
Age 70-74		5.20 ^a	.09	-.48 ^a	.10
Age 75-79		11.65 ^a	.11	-1.16 ^a	.10
Age 80-89		21.18 ^a	.11	-1.98 ^a	.10
Age 90-99		34.30 ^a	.28	-5.38 ^a	.21
Mean		26.77		20.78	
N		2,589,758		2,589,758	
R-square		.0482		.0074	

Notes: Coefficients and robust standard errors reported in percentage points. Categories omitted from the regression are: not in system, 1985, more than 250 beds, nonprofit, nonreligious, not contract managed, nonteaching, male, nonblack, and age 65-69. Coefficient estimates for demographic interaction terms and hospital fixed effects not presented. ^a Significant at p<.01 level; ^b Significant at p<.05 level.

APPENDIX 1.B **Do System Affiliations Affect Patient Transfer Destinations?**

The Effect of System Affiliations on the Likelihood of Receiving a Transfer (Based on Transfers of California Local System Hospitals, 1985-1998)			
Hospital Characteristics: Recipient Hospital	Coefficient	SE	Risk Ratio=Exp(Coefficient): Likelihood of Being Chosen as Transfer Recipient Due to Characteristic, Relative to Omitted Characteristic
Is System Partner	1.1831 ^a	.0482	3.26
Is in a Local System, but is not a Partner	-.1924 ^a	.0385	.83
Is in a Nonlocal System	-.0603	.0625	.94
Provides Catheterizations	.9355 ^a	.1795	2.55
Provides PTCAs	1.8011 ^a	.1809	6.06
Provides Catheterizations and Transferring Hospital Doesn't	1.9880 ^a	.2534	7.30
Provides PTCAs and Transferring Hospital Doesn't	3.2854 ^a	.1976	26.72
Is Nonprofit	.1804 ^a	.0565	1.20
Is Nonprofit and So Is Transferring Hospital	-.1866 ^b	.0826	.83
Has Religious Affiliation	.0393	.0352	1.04
Is Teaching Hospital	.1028 ^a	.0374	1.11
Is Contract Managed	-.7242 ^a	.1027	.49
Distance in Miles	-.1973 ^a	.0028	.82
Distance Squared	.0012 ^a	.0000	1.00

Note: These are the results of a multinomial logit based on 7,179 transfers.

^a Significant at p<.01 level.

^b Significant at p<.05 level.

APPENDIX 1.C.1

Does Nonrandom Hospital Selection Into Systems Affect Regression Results?

Is Future Joining of Systems Associated with Differences In Treatments, Payments, and Outcomes 1985-95?											
Independent but Will Join System:	Transferred	Catheter Within 90 Days		PTCA/CABG Within 90 Days		Log 90-Day Payments		90 Day Mortality			
	Years	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Small											
Local	85-91	-.77	.98	-.50	1.05	.43	.87	-1.73	1.80	1.88	1.35
	92-95	1.35	.99	1.14	1.01	1.34	.93	2.41	1.60	-3.10 ^a	1.02
Local+ BigPart	85-91	.05	1.16	-1.50	1.22	-2.27 ^b	1.02	-.11	2.11	1.16	1.49
	92-95	2.88 ^b	1.32	4.15 ^a	1.38	1.92	1.25	2.45	2.13	-1.53	1.34
Nonloc.	85-91	-2.07	1.98	-.31	2.04	.07	1.72	-.36	3.18	-2.00	2.36
	92-95	.29	3.73	.99	3.85	-1.97	3.46	-10.12	6.46	8.20	4.68
Medium											
Local	85-91	-1.52 ^b	.62	-.35	.97	-.69	.83	-1.26	1.51	-.97	1.14
	92-95	-1.65 ^a	.46	.42	.59	.65	.56	-.79	.91	.11	.57
Local+ BigPart	85-91	2.53 ^a	.91	-3.20 ^a	1.07	-1.37	.95	1.15	1.78	1.13	1.21
	92-95	1.38 ^b	.57	.58	.69	-.30	.64	-2.25 ^b	1.07	1.48 ^b	.67
Nonloc.	85-91	-1.13	1.20	1.05	1.71	.82	1.50	-3.05	2.61	2.12	1.86
	92-95	1.72	3.11	-5.85	3.40	-.49	3.20	-4.26	5.15	8.18 ^b	3.55
Big											
Local	85-91	1.52 ^a	.30	.75	.71	-.52	.63	2.87 ^a	1.03	.71	.74
	92-95	-5.52 ^a	.23	.52	.68	.96	.68	-8.98 ^a	1.04	-.21	.64
Local+ BigPart	85-91	-.12	.63	.09	1.17	-.72	1.04	2.28	1.98	-1.46	1.28
	92-95	-.32	.45	.21	.67	-.03	.63	6.41 ^a	1.05	-.52	.63
Nonloc.	85-91	1.60	.79	2.74	2.52	1.05	2.35	1.55	3.61	-2.42	2.69
	92-95	-6.96 ^b	1.53	2.74	4.19	5.07	3.97	-7.88	5.63	-.34	3.84

Notes: Coefficients and robust standard errors reported in percentage points. Variables noted in Appendix 1.A are also included, as are system variables for hospitals remain in systems and hospitals that leave systems. The coefficients therefore measure effect relative to independent hospitals that remain independent. N=1,596,689, except for log 90 day payments, where N=1,593,140.

^aSignificant at p<.01 level.

^bSignificant at p<.05 level.

Appendix 1.C.2:
Does Nonrandom Hospital Selection Into Systems Affect Regression Results?
For Comparison: Basic OLS Regression Results for 1985-1995 Only

Is Current System Membership Associated with Differences In Treatments, Payments, and Outcomes 1985-95?											
Current System:	Transferred	Catheter Within 90 Days		PTCA/CABG Within 90 Days		Log 90-Day Payments		90 Day Mortality			
	Years	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Small											
Local	85-91	-1.08 ^a	.28	-.67 ^b	.31	-.38	.27	-.19	.50	.16	.36
	92-95	-.45	.30	-.62	.33	-.48	.29	-1.46 ^a	.52	-.13	.35
Local+	85-91	-1.41 ^a	.36	-.34	.39	-.23	.34	-.30	.65	.39	.45
BigPart	92-95	.37	.37	.29	.40	.08	.36	-.90	.64	-.15	.42
Nonloc.	85-91	-.15	.38	-.67	.41	-.15	.35	-.97	.67	.75	.48
	92-95	.36	.46	-.39	.49	.50	.45	-2.54 ^a	.76	.29	.52
Medium											
Local	85-91	-.06	.18	-.06	.24	-.16	.22	2.00 ^a	.38	-.29	.26
	92-95	-2.97 ^a	.18	-.57 ^b	.26	.66 ^a	.24	-3.57 ^a	.40	-.37	.26
Local+	85-91	.55 ^a	.21	-.03	.27	-.61 ^b	.25	2.02 ^a	.44	-.72 ^b	.30
BigPart	92-95	-1.46 ^a	.22	.02	.29	.38	.27	-2.53 ^a	.45	-.23	.29
Nonloc.	85-91	.97 ^a	.23	-.75 ^b	.32	-.35	.30	2.86 ^a	.50	-.15	.35
	92-95	-3.22 ^a	.28	-.23	.40	.92 ^b	.38	-4.36 ^a	.61	-.80 ^b	.40
Big											
Local	85-91	1.09 ^a	.11	.41	.24	.04	.22	1.37 ^a	.36	-.16	.25
	92-95	-4.13 ^a	.13	.51	.27	1.64 ^a	.26	-4.44 ^a	.41	-.26	.27
Local+	85-91	-.70 ^a	.17	.16	.30	-.47	.28	2.67 ^a	.47	-.33	.32
BigPart	92-95	-3.52 ^a	.19	.93 ^b	.37	.77 ^b	.36	-3.54 ^a	.56	.51	.36
Nonloc.	85-91	.88 ^a	.21	.58	.41	.52	.39	4.07 ^a	.62	-.25	.42
	92-95	-3.98 ^a	.23	.59	.51	1.88 ^a	.50	-4.15 ^a	.75	-1.06 ^b	.49

Notes: Coefficients and robust standard errors reported in percentage points. Variables noted in Appendix 1.A also included. N=2,050,550, except for log 90 day payments, where N=2,045,627.

^aSignificant at p<.01 level.

^bSignificant at p<.05 level.

2 Hospital-Physician Affiliations: Development & Evolution

Traditionally, hospitals and physicians independently provided inputs into the medical care production process. Physicians cared for their patients in hospitals using hospital resources, but rarely were employed by hospitals or had any sort of contractual, financial, or other obligations beyond those associated with hospital admitting privileges. During the 1990s, however, formal relationships between physicians and hospitals became increasingly prevalent. While one theoretically possible motivation for the development of hospital-physician affiliations (HPAs) would be to control costs, a more likely motivation stems from the proliferation of managed care. Through formal affiliations, physicians and hospitals can combine their services to offer attractive packages to payers seeking to limit the number of contracts that they must negotiate and monitor.³⁵ Another related motivation is that affiliations may help providers bear (and share) risk shifted by managed care or other payers. Finally, certain forms of integration may be undertaken in part to ensure a more steady flow of patient admissions to the hospital.³⁶ According to an Ernst & Young study, hospitals' main objectives in forming affiliations were to improve relations with physicians, to share financial risk, and to raise the quality of care.

Relationships between hospitals and physicians have taken many forms, varying in both the degree and the nature of integration between the participating parties. These affiliations have spread quickly. For example, fewer than two percent of American Hospital Association 1994 study hospitals participated in a physician-hospital

³⁵ An association between HPAs and managed care penetration may result from the health care providers' desire to improve their marketability to managed care plans, but may also constitute the providers' attempts to respond to the increased competition in the market that may result from managed care.

organization (PHO) operated as a subsidiary or through a holding company in 1992. By 1993, however, nearly 18% of these study hospitals participated in a PHO through a hospital subsidiary, joint venture, hospital system, or other means, and by 1994, nearly 30% of hospitals participated.³⁷ About one third of physician groups reported participating in PHOs in the 1994-95 period (AMA Medical Group Survey 1996).

Table 2.1 reports the prevalence of various forms of hospital-physician affiliations during three years of the 1994-98 study period. (Section 2.1.1 will explain these arrangements in more detail.) The table shows that urban hospitals are more likely than rural hospitals to have HPAs. It also shows that HPA penetration for most HPA forms peaked in 1996, declining somewhat by 1998. The one exception to this rule is the integrated salary model HPA, which has a higher level of penetration in 1998 than in 1996.

Table 2.1
Percentage of Study Hospitals Involved in Hospital-Physician Affiliations

Year	All Hospitals			Urban Hospitals		
	1994	1996	1998	1994	1996	1998
Independent Practice Association	23.3	27.9	23.4	31.1	37.7	32.2
Physician-Hospital Organization	29.8	36.9	34.9	40.6	48.3	44.3
Any Low-Integration HPA	43.7	51.1	48.6	57.5	65.4	61.6
Group Practice Without Walls	7.3	8.3	5.3	10.0	11.8	7.0
Management Services Organization	17.4	25.6	20.8	26.1	39.2	30.1
Foundation Model	13.7	15.1	8.4	15.6	17.5	9.9
Equity Model	2.7	4.0	3.0	3.6	6.0	4.2
Integrated Salary Model	17.9	22.6	25.1	22.8	27.5	28.9
Any High-Integration HPA	41.1	49.3	45.1	51.8	61.9	54.6
Any Hospital-Physician Affiliation	61.4	69.6	68.1	74.4	81.9	79.0
Number of Study Hospitals	4,233	4,312	3,795	2,311	2,299	1,956

³⁶ See Duke (1996) for a discussion of motivations for vertical integration.

³⁷ The relatively recent vintage of PHOs is confirmed by a 1995 Ernst & Young survey of PHOs. Although 14% of PHOs had existed more than five years, about 75% of the surveyed PHOs were less than 25 months old and more than half were less than 1 year old.

Despite the proliferation of hospital-physician affiliations, relatively few studies have examined them in detail. In a 1998 article, Snail & Robinson wrote, “although some of the most dramatic recent revolution in hospital organization involves changes in the structure of hospital relationships with physician organizations and vertically (and virtually) integrated delivery systems, none of these phenomena has been subjected to multivariate statistical analysis.” My paper will contribute to the recent research intended to remedy this situation. In particular, I will explore the circumstances under which these organizational innovations occurred. I will examine the market and hospital characteristics associated with HPA formation, and the relationships among the forms. For example, do hospitals tend to adopt particular forms sequentially? Do they adopt multiple forms simultaneously and then drop some over time? Section 2.1 describes the nature of hospital-physician affiliations, reviews previous studies of affiliations, and explains the hypotheses I will be investigating.

2.1 Overview of Hospital-Physician Affiliations

2.1.1 Hospital-Physician Affiliation Types

As emphasized by Robinson & Casalino (1996), hospitals and physicians form many types of contractual relationships. This study will focus on seven types of hospital-physician affiliations about which the American Hospital Association collected information between 1993 or 1994 and 1998. The following descriptions of these hospital-physician affiliations draw heavily from Furrow et al. (1997), including Furrow citations of a Physician Payment Review Commission report (1995):³⁸

³⁸ Other helpful sources include the American Hospital Association survey, Snail & Robinson (1998), and Burns & Thorpe (1993).

Independent Practice Associations (IPAs). IPAs consist of loosely integrated physician practices, often brought together to facilitate managed care contracting. IPAs negotiate contracts with insurers and may pay physicians on a fee-for-service basis with a “withhold” (setting aside a portion of revenues to be distributed only if targets are met). The formation of an IPA may be sponsored by a hospital seeking to negotiate with a single physician entity rather than with individual physicians. IPAs often offer services such as billing and utilization review. Physicians can and often do belong to multiple IPAs.

Physician-Hospital Organizations (PHOs). PHOs join hospital and physicians in a single organization, which may negotiate contracts with health plans and provide utilization review, claims processing, credentialing, marketing, quality assurance and fee schedule development services. PHOs can serve as vehicles for hospitals to vertically integrate into physician practices, develop networks to supply inpatient admissions, diversify into non-hospital services, negotiate managed care contracts, and market and distribute hospital services (Snail & Robinson (1998)). In theory, they may also provide incentives for controlling costs, and provide assistance in increasing operational efficiency of the hospital and physician practices (AAMC (1993)). PHOs may be sponsored by a hospital that wants a closer relationship with (part or all of) its medical staff, or may be formed as a joint venture of the hospital and a multispecialty medical group or IPA. Physicians may continue to have a large amount of business outside of a PHO to which they belong, and like IPAs, PHOs may not have much influence on physician practice patterns. However, if PHOs can align incentives between physician and hospitals, they may lead to the restructuring of patient care.

Group Practices Without Walls (GPWWs). Hospitals may also become involved in GPWWs, which combine physicians into a single legal entity, and often provide management, staff, and administrative services. They may also provide some ancillary services such as laboratory services. GPWWs may purchase the assets of individual physicians, who then share the ownership of the GPWW as a whole, or may just enter management agreements with individual physicians.

Management Services Organizations (MSOs). Hospitals, group practices, or investors typically own MSOs, which provide administrative and practice management services to physicians. Hospitals may use MSOs to purchase the assets of physician practices, and then employ or contract with physicians directly for their services. MSOs may also contract with managed care plans.

Foundations (MFs). A hospital may establish a not-for-profit foundation to purchase the assets of a physician group, and then sign an exclusive professional services contract with the related physician corporation. Payers pay the foundation, which in turn pays the physician corporation. This is done in part to circumvent state laws prohibiting the corporate practice of medicine (laws that would be violated by direct hospital employment of physicians). Foundations may provide facilities and administrative services, as well as employing nonmedical personnel.

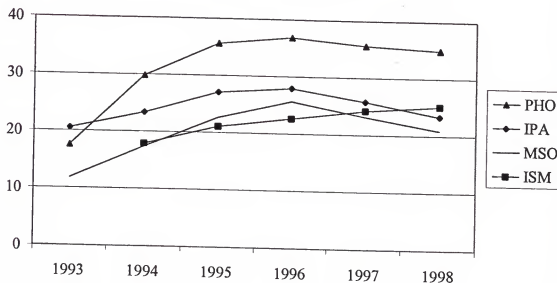
Equity models. The American Hospital Association defines an equity model as an arrangement which "allows established practitioners to become shareholders in a professional corporation in exchange for tangible and intangible assets of their existing practices."

Integrated Salary Models (ISM)/Employment. The AHA defines an integrated salary model as occurring when “physicians are salaried by the hospital or another entity of a health system to provide medical services for primary care and specialty care.” Hospitals may employ physicians whose practices they have purchased. (According to Snail & Robinson (1998), hospitals may hope that the purchase of practices will allow them to develop physician leadership, promote physician loyalty, expand into new areas, and recruit primary care physicians.) Traditionally, hospitals have also often employed physicians whose practices are based in the hospital, such as radiologists, pathologists, and anesthesiologists.³⁹

Figure 2.1 shows the trend in prevalence of the four most common HPAs: PHOs, IPAs, MSOs, and ISMs. PHOs have become the most popular form of HPA, and although their prevalence decreased somewhat between 1996 and 1998, its decline has not been as rapid as some of the other forms. The trends for MSOs and IPAs appear to have moved up -- and down -- together. And finally, while growth in the ISM form has been slow, it continued to grow through 1998.

³⁹ Hospitals may instead sign exclusive contracts with groups that provide medical services in the hospital. This a contractual relationship rather than an employment relationship, and probably would not be considered an ISM.

Figure 2.1
Percentage of Hospitals Participating in Hospital-Physician
Affiliations, 1993-98



2.1.2 Literature Review

Over the last 30 years, researchers have devoted considerable effort to understanding the nature of relationships between hospitals and physicians. Two articles written during the 1970s discussed the traditional relationship between hospitals and doctors and highlighted the sorts of problems it engendered. Harris (1977) depicted hospitals as suppliers of inputs, and physicians as demanders of hospital resources as inputs into the provision of the idiosyncratic medical care required by patients. Physicians had little reason to control hospital or other resource use, since they bore the cost of and received revenues for only their own professional services. Harris concluded that there would be "nothing but the ravages of excess demand unless the cost-minimizing incentive is transferred directly to the doctor part of the organization." A second article, Pauly & Redisch (1973), compared hospitals to physicians' cooperatives,

operated to maximize the net income for each member of the physician staff, subject to a break-even constraint for the hospital itself. In their model, physicians made decisions that enhanced their own productivity (or quality), and hence their own incomes, at the expense of other physicians. Cooperation could sometimes break down among cooperative members, allowing externalities to result in an inefficiently high level of quality and costs. Discussing the implications of this model, Sloan (1980) suggested that contractual arrangements might evolve to support a cooperative solution. Formally structured hospital-physician affiliations could fulfill this role.

There have always been some ties between hospitals and physicians, but these ties have been relatively weak. Hospitals sometimes directly employ hospital-based physicians such as radiologists, pathologists, and anesthesiologists. An employment relationship would allow hospitals more control over hospital-based physicians, and compensation formulas permit hospitals to shape financial incentives. Hospitals might also seek to draw physicians into their administrative decisionmaking process by hiring a director of medical education or a chief of staff, creating medical staff committees, or placing physicians on their governing boards. One study analyzing the association between these traditional forms of integration and hospital and market characteristics is Alexander, Morrissey & Shortell (1986). They found that the percentage of medical staff on payroll was positively associated with public ownership of the hospital, one measure of hospital regulation, hospital teaching status, smaller size, and location in the Northeast.

The integration strategies considered by Alexander, Morrissey & Shortell and authors that preceded them largely arose in an environment characterized by cost-based reimbursement methods. By the early to mid-1980s, however, a rapid rise in health care

costs had provoked responses by payers that permanently altered this environment. In 1983, Medicare, which accounted for over 25% of hospital reimbursement as of 1980,⁴⁰ began to pay hospitals using a prospective payment system. Instead of reimbursing hospitals for the cost of treatment, it paid hospitals based on the patient's diagnosis-related group, which was determined primarily by the patient's diagnosis or the major procedure performed. Private insurers soon began adopting similar payment systems. In addition, the growth of managed care between 1980 and 1990 contributed to the pressure on hospitals to control costs; HMOs often negotiate directly with hospitals to obtain the lowest prices possible. One potential way for hospitals to exercise greater control over their resources is to form closer relationships with the physicians that make decisions about the use of these resources (see Conrad (1988)).

A need for cost control is by no means the only explanation for the current wave of integration attempts, however. Cost control efforts and new treatment technologies have led to a dramatic decline in hospital stays, and hospitals may be turning to closer ties to physicians to increase the likelihood that physicians will refer patients. As more treatments are performed in an outpatient setting, hospitals may choose to affiliate with physicians and physician groups in joint ventures rather than to compete against them. In addition, while managed care organizations and self-insuring employers may choose to contract with physicians and hospitals separately, they may search instead for physicians and hospitals willing to join together to offer a single comprehensive package of inpatient, outpatient and physician services. Physicians may turn to these integrated organizational forms as a way of reducing the considerable administrative burden they face. In an Ernst & Young survey of PHOs, reasons cited for the formation of the PHO

⁴⁰ Statistical Abstract of the United States, 1982-83, tables 150 and 154.

included managed care contracting, employer direct contracting, collaboration with the medical staff, improving relationships with physicians, sharing financial risk, and enhancing quality of care.

Goals like increasing admissions, improving relationships with physicians, and enhancing the quality of care are presumably shared by most hospitals. But American Hospital Association survey data reveal considerable variation in hospitals' likelihood of adoption of any given HPA structure. Several authors have begun to explore hospital-physician organizational structures and the factors associated with their adoption.

Alexander et al. (1996) examined HPA proliferation in 79 hospitals that were part of 10 hospital systems. While not representative, this sample revealed a high degree of variation in the structures adopted. Examining descriptive statistics, Alexander et al. found that HPAs (including IPAs, GPWWs, PHOs, MSOs, MFs, outpatient divisions, and ISMs) were most common for smaller and larger hospitals (relative to mid-sized hospitals), those with market HMO penetration of over 15%, those with higher occupancy rates, and those in regional systems, although these results were not always statistically significant. The HMO penetration variable was an especially strong predictor of participation; 73% of hospitals in areas with greater than 15% penetration participated in at least one arrangement, while only 30% of hospitals in areas with less than 15% penetration did so. Many hospitals participated in more than one arrangement. The extent to which physicians were involved in these arrangements varied widely, with PHOs involving the highest proportion of medical staff and foundations the lowest.

Morrissey et al. (1996) also examined characteristics associated with hospital-physician organizational arrangements, but used a much broader sample: 1495 hospitals

that responded to a 1993 Prospective Payment Assessment Commission survey. They found that about 23% of community hospitals participated in at least one arrangement (PHO, MSO, foundation, or an integrated healthcare organization). The distribution of these organizations varied greatly geographically; 47% of hospitals in the Northeast participated in at least one arrangement, while only 14% of hospitals in the West North Central area did so. One-third of urban hospitals but only 11% of rural hospitals participated. Participation was also more likely for teaching hospitals, large hospitals, system hospitals, and nonprofit hospitals. The percentage of the hospital's revenue received from managed care was associated with the prevalence of arrangements. The authors did not examine the association between organizational arrangements and market managed care penetration, and did not attempt to disentangle the determinants of organizational adoption through regression analysis.

Mark et al. (1998) did perform a regression analysis. They used a logistic analysis to examine nine separate integration strategies, including traditional integration strategies such as the percentage of governing board members that were physicians, and more recent strategies such as hospital provision of practice management services to physicians (as in an MSO). The authors regressed an indicator of strategy adoption between 1991 and 1993 on hospital ownership, system membership, log discharges, percentage of hospital's revenues from Medicare and Medicaid, the wage index, case mix index, urban location, log HMO enrollment per capita, log of hospital beds, physicians per capita and physicians under age 35, total margins in 1991, average Medicare costs in 1991, and whether other hospitals in the MSA adopted the same strategy. Their results showed that government, teaching, and urban hospitals, and hospitals with higher

percentages of Medicare and Medicaid patients, were less likely to offer practice management services. Hospitals which participated in systems, treated more complex cases, had higher Medicare costs in 1991, and were near other hospitals that provided management services were more likely to provide these services themselves.

The most comprehensive article using regression analysis to examine the factors associated with formation of HPAs is Burns et al. (2000).⁴¹ The Burns study used AHA data from 1993 to 1995 for all urban hospitals that themselves sponsored HPAs (as opposed to participating in HPAs through systems or networks). One dependent variable was the presence of any HPA (IPA, PHO, MSO or MF, the HPA types for which information was available in 1993).⁴² Using a random effects model accounting for the correlation of error terms within MSAs, they found that HPA presence was positively associated with the number of HMOs in the MSA, negatively associated with log MSA population size, positively associated with the proportion of MSA physicians that were primary care physicians, and negatively associated with mean hospital occupancy in the MSA. HPA presence was also negatively associated with hospital system membership, public ownership, and teaching hospital membership, but positively associated with for-profit status, church ownership, and log hospital size. Furthermore, using a difference model, the authors found that initiation of an HPA was negatively associated with a change in the number of HMOs and changes in hospital size, but positively associated

⁴¹ Burns et al. (1997) also examined the adoption of HPAs. The authors evaluated a four-stage model of market evolution associating HPA types with market characteristics expected to evolve in a particular way. In the model's first stage, there would be less than 10% managed care penetration, and little cost pressure on hospitals, and therefore little motivation to integrate. As the stages proceeded, managed care penetration would become greater, cost pressures stronger, and physicians and hospitals more integrated. But evidence from 62 markets between 1992 and 1995 failed to support this model.

⁴² Burns et al. also constructed a separate analysis that included GPWWs, equity, and ISM models beginning in 1994. In addition, they performed regressions of the number of various types of HPAs (e.g.,

with the number of HPAs in the market in 1993 and the interaction term between the change in market penetration and the change in the number of HMOs. Based on their results, the authors concluded that affiliations were likely undertaken for contracting purposes -- to increase bargaining power -- rather than to address cost containment pressures.

2.1.3 Theories of Hospital-Physician Affiliation Development & Evolution

The Burns et al. analysis provides a foundation upon which this chapter will build; this chapter will begin by analyzing the characteristics associated with the existence of HPAs. It will then extend the Burns analysis in several ways. It will examine rural as well as urban hospitals, take into account hospital participation in HPAs through their systems and networks, and follow HPA patterns through 1998. It will also apply a variety of statistical techniques not used by Burns, including a proportional hazard model of hospital HPA adoption. But the main contribution of this chapter will be to analyze in more detail the patterns of adoption and evolution of hospital-physician affiliations.

First, it will consider the factors that affect HPA adoption patterns. For example, how do early adopters of HPA forms differ from late adopters? Have HPA forms spread geographically, or from big hospitals to smaller hospitals, or vice versa? Also, it will test for an effect of competition on HPA adoption, attempting to separate a competitive effect from a general area effect. Previous authors, such as Mark et al. (1996), have found some evidence of a "bandwagon effect," where hospitals are much more likely to adopt a strategy if a competitor has previously adopted it. If many hospitals in an MSA have

"sum of 2 loose" HPAs, defined as IPA and PHO). These results were for the most part similar. They noted that the results were similar across individual HPA types.

already adopted a particular form of HPA, a hospital that has not yet adopted may follow their lead, learning from their experiences or responding to conditions (such as HMO penetration or employer contracting) that pertain to the entire region.⁴³ If, however, geographically close competitors have an independent impact on the hospital's decision to affiliate, then perhaps HPA formation is a direct competitive response to prevent the loss of market power or patient admissions.

The study will also consider the determinants of the number of HPAs in which a hospital participates. Alexander et al. (1996) points out that participation in multiple HPAs may be difficult from a managerial perspective, but that variety may be necessary to accommodate physicians with heterogeneous demands. This may be especially true for nonprofit hospitals, which (as Conrad et al. (1988) suggest) may have heterogeneous goals themselves. It is also possible that hospitals try multiple integration strategies because they do not know which will prove most successful in accomplishing their goals. If the explanation for the adoption of multiple HPAs were survival-of-the-fittest experimentation on the part of hospitals (or physicians), the average number of HPAs in which hospitals were involved would fall as total HPA penetration rises, since hospitals in high-HPA areas should be able to learn from their neighbors' experiments. If this were true, we might also see a general tendency to participate in fewer HPAs in later years. Finally, the number of HPAs should be inversely related to the length of time the hospitals were involved with any HPAs, although this effect would be dampened if previous HPA experience lowers the costs of entering subsequent HPAs.

⁴³ There is a discussion of literature investigating both "learning by doing" and "learning by watching" in Ho (2000).

Taking advantage of the longer time series now available, this chapter will also examine the evolution of hospital-physician affiliations over time. One theory of HPA evolution is that some of the HPA types serve as teaching tools, and that when the participants have learned enough, they will graduate to a more sophisticated, more integrated form of organization. As summarized by Furrow (1997):

Many health industry experts believe that some of the new integrating organizations such as PHOs and MSOs are really transitional vehicles that will serve to "acclimatize" hospitals and physicians to the new environment created by managed care. By this account, after becoming accustomed to cooperating with each other, most providers will ultimately wind up in more fully integrated organizations that entail employment relationships and asset purchases.

This view, particularly with respect to PHOs, is readily apparent in industry sources.

Ernst & Young (1995) stated that a "PHO may be viewed as a transition state for hospitals and physicians on a path toward greater horizontal and vertical integration. The PHO provides the opportunity to explore their capacity and compatibility for joint contracting." A PHO CEO echoed this view, saying that "PHOs are primarily devices for physicians and hospitals to learn to integrate clinically and financially" (Janklevic (1995)). A consultant who believed that PHOs were transitional vehicles to other strategies, such as buying physician practices, said: "I think PHOs have a shelf life of about 3 to 5 years. I think the primary value is getting physicians and hospitals to sit down to talk to each other (as business partners)" (Janklevic (1995)).

A sufficiently long time series of indicators of hospital participation in PHOs should provide some evidence as to whether PHOs are indeed just instruments for learning to cooperate. Comments in the trade press suggest that the organizations may have to learn for themselves how to collaborate, as opposed to relying on the experience of others. If this is the case, most hospitals should have to first go through some less

integrated form of affiliation, and then progress to a more integrated form. If PHOs and other similar structures are simply suboptimal organizational forms adopted mistakenly, on the other hand, or if learning can occur through the experience of nearby institutions, then late adopters might expect to leap directly into more integrated forms of organization.

There has been limited investigation of organizational evolution of hospital-physician relationships. In their 1996 paper, Alexander et al. asserted that because they found that ISMs were the most prevalent among the forms of integration they studied, adoption decisions may have been based more on market, history, or cultural characteristics than on a developmental sequence from less to more tightly-coupled forms. However, Alexander et al. studied only cross-sectional data, and the hospitals in the sample might have already begun to evolve. Table 2.1 indicates that while the penetration of PHOs began to decline in 1996, the penetration of ISMs continued to increase in prevalence through 1998, a pattern that is consistent with evolution from PHOs to ISMs. Using a regression analysis and data from the 1994 through 1998, this chapter will analyze whether there is a pattern of transition from PHOs to ISMs, or more generally from low-integration HPA forms to high-integration HPA forms.

Section 2.2 describes the data used in the analysis. Section 2.3 evaluates the characteristics of hospitals that have hospital-physician affiliations. Section 2.4 examines the patterns of HPA adoption, and Section 2.5 traces how HPA forms change over time.

2.2 Data

The main source of data for this study is the American Hospital Association (AHA). To be included in the study (i.e., to be included in the most comprehensive

regressions in Section 2.3), a hospital must be a non-profit, for-profit, or nonfederal government hospital as documented by the AHA. In addition, the data used in the regressions must all be nonmissing, which requires either that the hospital respond to the annual survey, or that missing data be imputed based on information from surrounding years.

The dependent variables in this chapter's analyses are based on the American Hospital Association annual survey information on hospital-physician affiliations. In each year, 1994 through 1998, the survey asks in which of eight types of physician arrangements the hospital participates: independent practice association, group practice without walls, open physician-hospital organization, closed physician-hospital organization, management service organization, integrated salary model, equity model, or foundation.⁴⁴ While the hospital is asked to indicate whether the hospital itself participates, or whether the hospital participates through a health system or network, I have combined these responses into a dummy variable indicating whether the hospital participates, regardless of the avenue of participation. In addition, the PHO dummy variables used in this paper combine the responses to the "open" and "closed" questions.⁴⁵ Finally, various gap-filling and correction algorithms were applied.⁴⁶

⁴⁴ The American Hospital Association also collected information about a more limited set of hospital-physician affiliations in 1992 and 1993. In 1992, it asked whether PHOs, IPAs, groups, or MFs were hospital subsidiaries or holding company divisions. In 1993, it asked whether these entities along with MSOs were provided by the hospital, a hospital subsidiary, the hospital system, a joint venture, a contractual arrangement, or an other arrangement. I have avoided using this earlier data because of inconsistencies in the form of the survey questions (especially in 1992), the fact that information on several HPA types was not collected (particularly, information on ISMs), and limited availability of data for certain covariates.

⁴⁵ A closed PHO, unlike an open PHO, restricts physician membership according to a specific set of criteria.

⁴⁶ One- and two-year gaps in data, most often caused by failure to respond to the survey, were filled in with surrounding responses (if the surrounding responses were the same). In addition, if a hospital reported having a particular HPA type in one year, but then not the next, and then returning to the same type in the following year, the hospital was coded as having that HPA type in the intervening year. This

After the hospital-physician affiliation variables were coded, three aggregate HPA indicator variables were created: any HPA, low-integration HPA, and high-integration HPA. "High-integration HPAs" differ from the low-integration HPAs in that they are more likely to involve actively coordinated behavior between the hospital and the member physicians. Hospitals involved in PHOs or IPAs are involved in low-integration HPAs; hospitals involved with any other HPA form are involved in high-integration HPAs. This categorization is based on the work of Dynan et al. (1998).⁴⁷ It is also consistent with the continuum presented in Furrow et al. (1997).

In addition to ownership and affiliation, the AHA annual survey databases provide information about hospital bed size, multihospital system affiliations, teaching hospital status, contract management, and hospital occupancy levels. In the regression analyses in this paper, hospital bed size is calculated based on the number of adult acute care beds reported in the database; missing data is imputed based on data from previous and subsequent years. The local system affiliation variable is based on a combination of AHA survey responses and an AHA-coded system identifier; a hospital participates in a local system if it has any system partner within 100 miles. A hospital participates in a national system if it has any system partner farther than 100 miles. While this chapter makes use of the multihospital system identifiers developed in Chapter 1, it permits hospitals to simultaneously participate in local and national systems. A hospital is considered a teaching hospital if it reports having more than 20 residents. Contract

was done under the assumption that hospitals would rarely drop and resume participation in a particular affiliation type over such a short time period.

⁴⁷ Using survey data, Dynan et al. assessed the extent to which HPAs resulted in different types of integration, including hospital provision of administrative services to physicians, hospital and physician joint ventures to expand services, computer linkages, financial risk sharing, salaried arrangements, and physician participation in hospital strategic planning. Among other results, the authors found that IPAs had

management is defined on the basis of annual survey responses and a gap-filling algorithm based on surrounding survey responses and system identifiers. Hospital occupancy levels are calculated based on survey data as inpatient days divided by the product of hospital beds and days reported. In the regressions, previous year occupancy is used; in the fewer than one percent of observations where this information is missing, current occupancy is used. The final hospital regressor, case mix index, comes from the tables that appear annually in the Federal Register. Developed for use in conjunction with the Medicare program, case mix index serves as a proxy for the average patient severity of illness for a given hospital.

Additional sources of control variables include the Bureau of Health Professions' Area Resource Files (ARF) published in February 1998 and February 2000. The ARF, which draws its information from the census, the American Medical Association, and InterStudy, among other sources, contains historical demographic and health provider data at the county level. This dataset provides the populations used in the MSA size variables, as well as in the denominators of the HMO penetration, beds per capita, and physicians per capita variables. The ARF dataset also provides a count of the number of HMOs headquartered in a county (data that is then summed to the MSA level) and the number of physicians in a county (for rural hospitals) or MSA (for urban hospitals).

Finally, ARF contains InterStudy data which is the basis of the HMO penetration rates associated with rural hospitals. For the years 1994 through 1996, the 1998 ARF contains HMO enrollments by county; enrollees are assumed to live in the county that contains the HMO address. The 2000 ARF contains InterStudy County Surveyor

the lowest overall integration, and that there was a high degree of financial risk sharing within PHOs (but not necessarily a high degree of integration along other dimensions).

Database data for 1998. In this database, a number of HMOs have reported enrollment by county, and other HMO enrollments are allocated according to county populations. HMO penetration rates for rural areas in 1994-1996 and 1998 are calculated by summing these county enrollment figures by state, summing ARF populations by state, and then calculating total state penetration. Rural hospital HMO penetration for 1997 is the average of 1996 and 1998 figures. HMO penetration for urban hospitals, on the other hand, comes directly from the Interstudy Trend database, which contains total HMO enrollments by MSA for January of each year between 1994 and 1998. These HMO enrollments are used to calculate the MSA HMO penetration rate.

Means of the dependent variables were reported above in Table 2.1; means of the independent variables are reported in Appendix 2.A.1. Table 2.2 shows selected characteristics of hospitals that in 1994 had no hospital-physician affiliation, only low-integration HPAs, only high-integration HPAs, or both. Many of the variables display a trend reading across the columns. Hospitals with both low and high-integration HPAs, for example, tend disproportionately to be religiously affiliated, serve as teaching hospitals, participate in local systems, have a high case mix index, and be located in areas with high HMO penetration rates. For these variables, hospitals without any HPAs exhibited precisely the opposite characteristics, and low-integration and high-integration hospitals, in that order, came somewhere in between.

For other variables, the no-HPA and both-HPA categories served as endpoints, but the order of high-integration and low-integration only options was switched. While national system hospitals, large hospitals, high-occupancy hospitals, hospitals located in large MSAs, and hospitals located in areas with a high number of physicians and a low

number of beds per capita disproportionately prefer having both HPA types to no HPAs, they are more likely to choose low-integration HPAs only than to choose high-integration HPAs only. Governmental hospitals and contract managed hospitals, on the other hand, are disproportionately likely to choose no HPAs relative to both HPAs, but would prefer a high-integration HPA to a low-integration HPA.

For-profit hospitals do not display this no-HPA/both-HPA endpoint pattern. For-profit hospitals are disproportionately likely to participate in low-integration HPAs or both HPA types, and disproportionately unlikely to participate in high-integration HPAs only. Geographical patterns of HPA participation also vary, although the patterns are difficult to discern. The biggest disparities in geographical distribution are for hospitals in the New England and Pacific regions, which constituted a much larger fraction of both-HPA hospital types than of no-HPA hospital types.

Table 2.2
Characteristics of Study Hospitals by HPA Type, 1994

	No HPA	Low- Integration HPA only	High- Integration Only	Both Low & High- Integration
Number of Hospitals	1,633	861	750	989
Percentage of Hospitals That Are:				
For Profit	9.2	14.2	6.0	13.7
Governmental	38.3	24.0	29.7	11.5
Religious	7.0	11.1	12.5	20.4
Teaching	4.0	9.4	12.8	17.5
Local System	30.2	35.0	40.0	53.4
National System	29.9	33.1	31.9	44.7
Contract Managed	19.8	14.3	18.3	7.5
Mean Bed Size	77.9	120.9	118.9	168.3
Mean Hospital Case Mix Index	1.16	1.26	1.26	1.38
Mean Hospital Occupancy	44.9%	52.2%	49.1%	57.5%
Percentage of Hospitals in Areas That Are:				
Rural	63.7	39.5	47.9	18.4
Under 250k	8.6	10.9	9.9	8.8
250k to 1 million	11.8	19.2	17.6	22.3
More than 1 million	15.9	30.4	24.7	50.5
New England	2.5	6.4	4.5	6.2
Mid Atlantic	8.6	13.5	10.0	10.1
South Atlantic	15.3	13.2	14.4	15.4
East North Central	17.1	13.5	17.6	17.4
East South Central	11.5	7.2	5.9	5.7
West North Central	18.7	11.4	19.7	8.9
West South Central	14.0	17.8	10.5	13.2
Mountain	6.2	5.9	7.9	8.1
Pacific	6.1	11.1	9.5	15.1
Area physicians per 1,000 population	1.40	1.87	1.78	2.34
Area beds per 1,000 population	2.78	2.52	2.65	2.28
Mean HMO penetration	13.1%	14.7%	14.8%	18.8%

Appendix 2.A.2 graphically portrays affiliation trends within some of the hospital categories displayed above. Small hospitals show the same general trends as were visible in Figure 2.1, but at lower levels. System hospitals show steeper growth rates than visible in Figure 2.1, except for ISMs, for which the initial level is higher but the growth rate about the same. For-profit hospitals show perhaps the most interesting patterns; PHOs, IPAs, and MSOs all increased rapidly in prevalence to quite high levels, but then

decreased rapidly as well (and far more rapidly than for other hospitals). And ISMs have always been far less popular in for-profit hospitals than in other hospitals. Religious hospitals, on the other hand, appear to be much more willing than the average hospital to participate in all of these affiliation forms. The regressions in Section 2.3 will identify the extent to which these and other hospital and market characteristics affect hospitals' decisions to participate in hospital-physician affiliations.

2.3 Characteristics of Hospitals with Hospital-Physician Affiliations

2.3.1 Analyses & Results

Table 2.3 presents the results of two analyses of characteristics associated with participation in hospital-physician affiliations. The dependent variables (dummy variables indicating participation in any type of HPA, participation in low-integration HPAs (specifically, an IPA or PHO), and participation in high-integration HPAs (MSO, GPWW, MF, equity model, or ISM)) are listed across the top of the table, while independent variables are listed down the side. The first analysis is a probit analysis of hospitals' decisions to participate in the HPA type. Rather than reporting the coefficients resulting from the probit analysis, I have reported the marginal effects evaluated at the mean values of the regressors. The companion analysis is an ordinary least squares regression including hospital fixed effects.

Table 2.3
Hospital & Market Characteristics Associated with Hospital Participation in
Any, Low-Integration, and High-Integration Hospital-Physician Affiliations, 1994-98

	Probit Analysis Marginal Effects			OLS Analysis with Hospital Fixed Effects		
	Any	Low	High	Any	Low	High
For Profit	-4.9*	-1.0	-7.1*	-5.0	-8.3*	-3.2
Governmental	-8.4*	-10.9*	-8.1*	-6.1*	-4.1	-4.7
Religious	5.8*	3.9*	4.0*	7.4*	5.2	8.3*
Teaching	3.8*	-3.4*	6.2*	-1.5	-2.3	4.3
100-200 Beds	8.4*	10.2*	8.0*	.5	.5	-2.0
200-300 Beds	12.4*	13.3*	12.3*	2.8	1.0	.9
300+ Beds	10.4*	11.7*	14.0*	-.9	-2.8	-.9
Local System	9.4*	6.9*	13.6*	6.6*	6.7*	7.6*
National System	-1.3	1.6	-0.6	-.3	1.3	-2.2
Contract Managed	-4.0*	-3.8*	-6.5*	-.6	.4	-1.3
Case Mix Index	.2076*	.1915*	.1623*	.0194	-.0445	.0462
Previous Year Occupancy	.0817*	.0841*	.0560*	.0187	-.0059	.0002
1995	6.5*	6.9*	6.3*	6.4*	6.4*	5.8*
1996	8.4*	8.3*	8.9*	8.2*	8.0*	8.1*
1997	7.1*	6.4*	5.7*	7.0*	6.5*	5.4*
1998	7.2*	6.1*	4.0*	6.4*	5.4*	3.6*
5-15% HMO penetration	.0	.9	2.0	2.3	1.4	1.5
15-25% HMO penetration	.4	-.0	4.0*	2.7	1.7	2.2
25-35% HMO penetration	-1.5	-.5	.3	3.0	2.3	.1
Over 35% HMO penetration	-4.6*	-4.2*	-.4	1.4	1.0	-1.8
MSA Under 250k	1.9	3.0*	2.6			
MSA 250k to 1 million	6.9*	8.2*	9.1*			
MSA over 1 million	9.0*	17.1*	10.0*			
New England	14.2*	15.9*	10.3*			
Mid Atlantic	-2.5	1.4	-8.0*			
East North Central	3.3*	3.1*	6.1*			
East South Central	-6.0*	-2.4	-5.9*			
West North Central	7.2*	1.5	10.4*			
West South Central	7.5*	1.3*	3.2*			
Mountain	11.2*	10.3*	12.3*			
Pacific	9.0*	9.5*	5.6*			
Physicians per 1,000	.0199*	.0090*	.0136*	.0069	.0009	.0459
Beds per 1,000	-.0095*	-.0179*	-.0055	.0014	.0012	.0010

* Statistically significant at $p < .05$ level. Coefficients for dummy variables reported in percentage points. Full tables with standard errors reported in Appendixes 2.B.1 & 2.B.2.

Table 2.3 confirms that both hospital and hospital market characteristics affect hospital decisions to participate in hospital-physician affiliations. The probit analysis suggests that hospitals are more likely to sponsor HPAs if they are nonprofit, nongovernmental, religiously affiliated, or teaching hospitals. Hospitals are also more

likely to have HPAs if they are larger, are not contract managed, participate in a local multihospital system (although nonlocal partners don't seem to make a difference), treat more severely ill patients, and have higher occupancy levels. HMO penetration seems not to matter much, except possibly at the very highest levels of penetration, where for low-integration HPAs in particular, HMO penetration is associated with less entry into HPAs. Hospitals in bigger cities, with more physicians per capita but fewer beds per capita, are more likely to have HPAs. Finally, geographic region makes a big difference in the level of HPA penetration; all else equal, for example, HPAs are far more likely to appear in New England and Mountain states, for example, than in areas like the Mid-Atlantic or the East South Central United States.⁴⁸

There are only a few differences in direction between hospitals that tend to choose low-integration HPAs and hospitals that tend to choose high-integration HPAs. For profit hospitals are much less likely than nonprofits to choose high-integration HPAs, but are more similar in their tendency to choose low-integration HPAs. Teaching hospitals are more likely than nonteaching hospitals to choose high-integration HPAs, but less likely to choose low-integration HPAs. The prevalence of high-integration HPAs rises steadily with hospital size, but for low-integration HPAs, once hospital size reaches 100 beds, there seems to be little difference in prevalence. Finally, regional location can affect the likelihood of high and low-HPA penetration differently.

The ordinary least squares with hospital fixed effects analysis was included as a means of controlling for unobserved, unchanging characteristics associated with each hospital and/or its market area. In this regression, few of the coefficients (other than the

⁴⁸ An ordered probit, in which hospitals were classified according to whether they were not integrated, participated in a low-integration HPA only, or participated in a high-integration HPA, produced

year dummies) were significant, probably due in substantial part to the fact that the five-year analysis period did not allow for many changes in for-profit status, teaching status, etc. However, two regressors in particular reinforce the results of the probit analysis: religious hospitals and local system hospitals are much more likely to participate in HPAs than nonreligious hospitals and non-local system hospitals, respectively.

Table 2.4 replicates the probit analysis that is the basis for Table 2.3, but with three exceptions. First, it is analysis of only urban hospitals. This allows for the second difference: The regression includes MSA fixed effects, which control for unobserved, unchanging characteristics of city-wide markets. It also permits the third difference: Following Burns et al. (2000), it includes a variable measuring the number of HMOs in the MSA. In addition, Table 2.4 displays separate probit regression results for both of the individual forms of low-integration HPAs (IPAs and PHOs), and the two most common forms of high-integration HPAs (MSOs & ISMs).

coefficients which mirrored those in Table 2.3.

Table 2.4
Urban Hospital Participation in Hospital-Physician Affiliations, 1994-1998
Probit Analysis with MSA Fixed Effects: Marginal Effects

	Any	Low	High	Low-Integration		High-Integration	
				IPA	PHO	MSO	ISM
For Profit	-6.7*	-5.2*	-10.8*	3.6	-10.0*	2.6	-13.9*
Governmental	-7.0*	-22.3*	-8.8*	-16.2*	-18.5*	-18.6*	4.5*
Religious	6.0*	7.7*	4.0*	8.8*	2.2	4.2*	-.3
Teaching	2.4	-4.0*	5.3*	-4.2*	-2.0	-6.1*	7.1*
100-200 Beds	5.8*	6.4*	8.5*	2.0	6.6*	9.1*	3.5*
200-300 Beds	8.1*	9.6*	13.3*	2.8	8.9*	9.5*	6.8*
300+ Beds	7.9*	10.9*	16.1*	7.1*	10.9*	12.2*	11.0*
Local System	6.4*	5.8*	16.2*	3.9*	6.4*	15.9*	9.7*
National System	1.4	3.2*	2.1	3.5*	5.1*	-.4	2.0
Contract Managed	-4.1*	-5.0*	-8.1*	-3.8	-10.4*	-7.5*	-6.6*
Case Mix Index	.1335*	.1550*	.1298*	.1488*	.0920*	.1820*	.0183
Previous Year Occupancy	.1041*	.1404*	.0600	-.0058	.2191*	.0688*	.1332*
1995	3.1*	5.2*	5.4*	3.7	5.8*	7.4*	3.7*
1996	3.7*	5.6*	7.5*	4.3	6.0*	11.8*	5.7*
1997	.2	1.1	1.0	-.1	.2	3.5	6.5*
1998	-4.0	-2.8	-5.3	-5.5	-4.2	-3.2	7.8*
5-15% HMO penetration	3.5	1.2	4.0	.1	3.4	-.2	2.4
15-25% HMO penetration	3.7	3.2	3.7	1.2	3.2	4.2	1.6
25-35% HMO penetration	5.9*	6.4	3.7	4.6	7.6	1.9	-.5
Over 35% HMO penetration	5.3	5.0	1.2	2.0	4.9	1.6	-2.0
# HMOs in MSA	.0029	.0024	.0039	.0046*	.0011	-.0024	.0096*
Physicians per 1,000	.1879*	.1493	.1982*	.1418	.2069*	.1730*	.0209
Beds per 1,000	-.0438	-.0407	-.0491	-.0482	-.0299	-.0391	.0005

* Statistically significant at $p < .05$ level. Coefficients for dummy variables reported in percentage points. Full table with standard errors reported in Appendix 2.B.3.

While the results are on the whole very similar to those in Table 2.3, the combination of using only urban hospitals and including MSA fixed effects does introduce some changes. Several variables gain or lose statistical significance. For low-integration HPAs, for example, the regression indicates that for-profit status now has a significant and negative effect on adoption, while the national system variable has a positive impact on adoption beyond the local system effect. But the biggest changes are for the year dummies and for HMO penetration. The 1997 and 1998 dummy variables had had a positive effect, but now that effect is diminished or reversed and loses its statistical significance; this appears to be the result of including MSA fixed effects. In

addition, the HMO penetration variables now all have positive but (with one exception) insignificant effects. This is likely due to a combination of the inclusion of fixed effects, and the fact that for the rural hospitals included in Table 2.3 but not Table 2.4, HMO penetration was measured on the state rather than the local level.

Perhaps the most interesting results of this urban hospital probit analysis are those for the individual HPA types. The "low" and "high" categories do not capture the diversity of the HPA types they include. The individual regressions provide insight into the differences among HPA types:

(1) *IPA and MSO: Basic hospital characteristics.* While the IPA is considered a low-integration HPA, and the MSO a high-integration HPA, both forms tend to be chosen by the same groups of hospitals: non-governmental hospitals, religious hospitals, and non-teaching hospitals. PHOs and ISMs differ along several of these dimensions.

(2) *ISM: Government & Teaching hospitals.* Governmental hospitals and teaching hospitals are disproportionately likely to enter ISMs, despite being less likely to enter each of the other types of affiliations.

(3) *ISM: Hospital size.* While it is generally true that larger hospitals are more likely to enter HPAs, for many HPA types the effect is not linear. The effect does appear to be linear for ISMs, however. Relative to hospitals with fewer than 100 beds, 100-200 bed hospitals are 4% more likely to have ISMs, 200-300 bed hospitals are 7% more likely to have ISMs, and the largest hospitals are 11% more likely to have ISMs.

(4) *MSO & ISM: National system.* Having partners outside of the local area is positively and significantly associated with forming IPAs and PHOs, but not with the high-integration HPAs.

(5) *ISM: Year*. Holding other factors constant, most HPA types diffused from 1994 to 1996, but then stopped in 1997. ISMs continued to diffuse through 1998.

(6) *IPA and ISM: Number of HMOs*. The higher the number of HMOs in the MSA, the more likely hospitals were to participate in IPAs or ISMs. This is consistent with the findings of Burns et al. (2000). However, this effect does not appear to apply to either PHOs or MSOs.

2.3.2 Discussion

While not using all of the regressors as the Burns et al. analysis (and while excluding 1993), this paper has extended the Burns analysis by including rural hospitals and data from 1994 through 1998. Many of the results remain the same. For example, HMO penetration was largely insignificant as a determinant of HPA formation. Burns et al. chose to focus on HMO-related variables as regressors in large part because many analysts of hospital and physician organizations had thought that they were developing as a response to HMO pressures. The insignificance of these regressors implies that current HMO penetration makes little difference in hospital decisions to participate in HPAs. The direction of other significant regressors, such as public and religious ownership, hospital size, and year 1995, were also the same as those in the Burns analysis and statistically significant.

Other variables showed differences in patterns. For example, Burns showed that teaching hospitals were less likely to form affiliations, while the tables above suggest that they are more likely to form affiliations. This may be because only one of the Burns regressions included ISMs, the HPA form that produces the positive coefficient, and that regression included only two years of data. Because teaching hospitals have struggled to

maintain admissions, because they need to manage relationships with faculty, and perhaps because of the cost control pressures they face, it makes sense that they would be more likely to form affiliations than non-teaching hospitals.

Burns et al. also reported that system membership decreased the likelihood of forming HPAs, particularly low-integration HPAs. In contrast, the effect reported in the above tables is positive, and quite large, particularly for high-integration HPAs. As shown in Table 2.3, the effects of system status are positive even when controlling for hospital fixed effects. While the difference may be due to the use of revised system indicators, it may also be due to the fact that Burns article considered only affiliations that occurred through the hospital itself, as opposed to through the hospital system or network.

Particularly for the most widespread HPAs, it is true that the majority of arrangements appear to operate through the hospital itself. For the study hospitals in 1994, for example, 17% of hospitals participated directly in an IPA, while 6% participated through systems or networks. For some of the more integrated and less widespread HPAs, however, systems seem to matter more. In 1994, 10% of hospitals participated directly in an MSO, while 8% participated through a system or network. The importance of local hospital systems to high-integration HPAs is also apparent in Table 2.4: The impact of local systems, while positive for both low- and high-integration HPAs, is much stronger for high-integration HPAs including MSOs and ISMs, and less widespread HPAs like equity models and GPWWs.⁴⁹ It is possible that the high-

⁴⁹ A logit analysis reveals that in general, system hospitals are less likely to engage in low-integration HPAs only, and instead are much more likely to engage in both low- and high-integration HPAs simultaneously. Using the estimates from the logit analysis, treating all hospitals as alternatively all local system hospitals or all non-local system hospitals, and holding all other factors constant, the predicted

integration models require more effort and expense on the part of participating hospitals, and therefore are more readily undertaken by hospitals that can pool their administrative resources through system affiliations. This may be especially true of less common forms of HPAs, for which a model may need to be developed internally.

The coefficients for national system in Table 2.4 suggest that system status may be important for other reasons as well (although these results are not as consistent as the local system results -- they do not appear in Table 2.3). Having partners outside of the local area (regardless of whether the hospital also has partners within 100 miles) is positively associated with hospitals entering into less integrated (but not more integrated) forms of hospital-physician affiliations. A possible explanation is that the general expertise in alliance formation available at a distant system headquarters may be more helpful with respect to HPA forms with a limited hospital role than with respect to HPA forms requiring more proactive hospital management.

The other striking pattern visible in these tables is how different the ISM model is from the others. As mentioned previously, it is the only model of the four displayed in which government hospitals and teaching hospitals disproportionately choose to participate. These hospital types are likely to have different needs than other hospitals; both hospital types may face more severe cost pressures than other hospitals, for example, so perhaps they see this tight form of integration as a response to that issue. Teaching hospitals may also prefer employment relationships with physicians because of their need to maintain the teaching function. But the fact that ISMs continue to grow in

participation in HPAs is as follows:

	None	Low	High	Both
Local System Members	18%	18%	18%	46%
Locally Independent Hospitals	24%	26%	16%	34%

prevalence through 1998 (both in absolute terms, as shown in Table 2.1, and controlling for other factors, as shown in Table 2.4) suggests that something in the general environment facing hospitals is changing so as to make ISMs more attractive.

2.4 Patterns of Hospital-Physician Affiliation Adoption

While Section 2.3 examined the characteristics associated with maintaining a hospital-physician affiliation, this section will examine the characteristics associated with the formation of HPAs. What characteristics are most associated with HPA formation? How have these characteristics changed over time? How do late adopters of HPAs differ from early adopters -- in other words, how do these forms spread? Does one hospital's formation of an HPA drive its neighbor's formation of an HPA?

One way of examining adoption questions is through the use of a proportional hazards model (see, e.g., Baker & Phibbs (2001)). The hazard rate is the rate at which "death" occurs after time t , given that the subject has survived until time t . In this case, the hazard rate would be the rate at which hospitals form a particular type of HPA, given that they have not previously formed an HPA. In the Cox proportional hazards model used here, there is a baseline hazard rate which is shifted by the covariates specified in the model. The equation is of the form $h_i(t) = h_0(t) * e^{B'x_i}$, where $h_0(t)$ is the baseline hazard rate (which is not estimated) and x_i are the covariates. The covariates consist of the same regressors included in tables in the previous section.

For most of the HPA types, the proportional hazard model estimation treats hospitals as if they first opened in 1993, and then first decided whether to adopt an HPA at year 1 (1994). The AHA Annual Survey from 1993 included questions about whether hospitals participated in IPAs and PHOs (the "low" HPA types), and MSOs. In part

because the 1993 questions do not cover all of the HPA types considered here, I did not use 1993 data in the Section 2.3 estimates. Because there was a significant increase in the prevalence of these models between 1993 and 1994, however, the results presented in the following tables use 1993 wherever possible.⁵⁰ For these models, hospitals are treated as if they opened in 1992, and could first decide whether to adopt HPAs in 1993.

Table 2.5 presents the results of a hazard model based on all hospitals, both rural and urban. The model results are presented in terms of hazard ratios (e^B), where ratios greater than 1 indicate that a hospital with that characteristic is more likely to adopt that form. So, for example, government hospitals have an overall HPA adoption hazard about 18% lower than nongovernmental hospitals, while local system members have an adoption rate about 18% higher than non-local system hospitals.

⁵⁰ The low, IPA, PHO, and MSO models all include 1993 data. In 1993, 20.5% of hospitals had IPAs, 17.5% had PHOs, 30.4% had either IPAs or PHOs (i.e., a low-integration HPA), and 11.7% had MSOs. The effect of including 1993 data was largely to increase levels of statistical significance; there were few significant changes in hazard ratio estimates.

Table 2.5
Hazard Model: Hospital Adoption of Hospital-Physician Affiliations
Hazard ratios

	Any	Low	High	Low-Integration		High-Integration	
				IPA	PHO	MSO	ISM
For Profit	.987	1.090	.893	1.094	1.043	1.318*	.619*
Governmental	.825*	.743*	.798*	.740*	.689*	.591*	.850*
Religious	1.094	1.165*	1.088	1.208*	1.137	1.212*	1.021
Teaching	1.015	.857*	1.089	.898	.861	.829*	1.411*
100-200 Beds	1.153*	1.243*	1.147*	1.165*	1.283*	1.298*	1.207*
200-300 Beds	1.166*	1.291*	1.219*	1.118	1.377*	1.312*	1.226
300+ Beds	1.155	1.338*	1.207	1.206	1.408*	1.442*	1.334*
Local System	1.177*	1.122*	1.380*	1.143*	1.163*	1.604*	1.399*
National System	.950	.958	.987	.909	1.033	.997	.950
Contract Managed	.972	.996	.872	.915	.978	.797*	.829*
Case Mix Index	1.362*	1.472*	1.432*	1.286	1.523*	2.040*	1.132
Previous Year Occupancy	1.213	1.163	1.132*	1.083	1.257	1.091	1.249
1994 (in models including 93)		.791		.735	.906	1.845	
1995	.969	1.565	.823	1.203	2.306	1.556	1.110
1996	1.437	.901	1.621	.969	1.438	3.507*	2.371
1997	.616	.225	.938	.171	.272	1.988	.598
1998	.988	1.166	1.047	.841	.973	1.308	1.252
5-15% HMO penetration	1.003	.950	1.034	.963	1.002	1.010	1.212*
15-25% HMO penetration	.989	.967	1.049	.944	1.035	1.054	1.321*
25-35% HMO penetration	.971	.938	1.017	.992	.982	1.034	1.222
Over 35% HMO penetration	.914	.940	.967	.972	.836	.886	1.189
MSA Under 250k	1.068	1.105	1.205*	.942	1.228*	1.509*	1.267*
MSA 250k to 1 million	1.170*	1.301*	1.315*	1.272*	1.369*	1.701*	1.444*
MSA over 1 million	1.157*	1.540*	1.313*	1.831*	1.410*	1.880*	1.322*
New England	1.195	1.386*	1.088	1.747*	1.357*	1.071	1.484*
Mid Atlantic	.985	.993	.882	1.265*	.921	.921	.850
East North Central	1.031	1.124	1.059	1.201	1.137	1.087	1.223*
East South Central	.872	.967	.749*	1.086	.864	1.089	.604*
West North Central	1.047	1.010	1.099	1.062	1.037	.865	1.481*
West South Central	1.106	1.259*	.951	1.250*	1.384*	1.242*	.762*
Mountain	1.279*	1.342*	1.215*	1.962*	1.149	1.000	1.234
Pacific	1.173*	1.262*	1.058	2.101*	.539*	1.043	.686*
Physicians per 1,000	1.032	1.002	1.028	.978	1.053*	1.030	.982
Beds per 1,000	.986	.967	.990	.999	.897*	.938*	1.044

* Statistically significant at $p < .05$ level. Full table with standard errors reported in Appendix 2.C.1.

As might be expected, the adoption hazard ratios in many ways mirror the probit model results presented earlier. Bigger hospitals, hospitals in bigger cities, and local hospital system members tend to be more likely to adopt all types of HPAs than other hospitals, although size seems to matter less for the sponsorship of IPAs (which tend to

involve less hospital commitment than other forms). MSOs and ISMs tend to attract very different hospitals; for-profit hospitals are far more likely to adopt MSOs and less likely to adopt ISMs, while teaching hospitals show the opposite pattern. Contract managed hospitals are less likely to adopt high-integration HPAs forms, but not necessarily low-integration forms. HMO penetration seems to matter only for ISMs.

There is also tremendous regional variation in the tendency to adopt specific forms of HPAs. The New England and Mountain regions seem more likely than other regions to adopt HPAs, with the exception of MSOs. For ISMs, New England and the West North Central regions have 50% higher adoption hazards than the omitted South Atlantic category, while the East South Central area has a 40% lower adoption hazard. And finally, the Pacific region shows the greatest dispersion in adoption hazards across types: relative to the South Atlantic region, hazard ratios for adoption of IPA are more than twice as high, but hazard ratios for PHO adoption are only slightly more than half as much. This statistic is consistent with trade press discussions of the importance of risk-bearing physician IPAs in California in the provision of services to managed care enrollees.

Another way to look at the adoption question is to consider adoption order. In a hazard model, covariates are constrained to have a fixed effect on the adoption hazard rate. What if hospital and market factors play a different role in early adoptions than in later adoptions? To explore the degree to which hospital and market effects varied across periods, I created two probit models. The first included only 1994 observations, asking the question, which types of hospitals had adopted any HPA by 1994? The second included 1995 through 1998 observations for hospitals that had not previously adopted an

HPA up to the year in question. The results in Appendix 2.C.2 suggest that the effects of several factors, such as governmental or religious status, stay constant across time. The effects of other factors, however, matter less. The positive effects of hospital size, MSA size, and many effects of region disappear or become statistically insignificant for late adopters. It may be that bigger hospitals had more resources to develop new forms of arrangements, and that geography mattered when a hospital had to make an independent decision about forming a new HPA. However, once HPAs became sufficiently widespread that most hospitals could see how they functioned, and their costs and benefits, factors like size and geography made less of a difference.⁵¹ On the other hand, one market-related factor did matter more for late adopters: Physicians per capita seemed to make little difference for 1994 adopters, but had a positive effect thereafter. Perhaps physicians became more proactive later in the process, when they recognized the value of HPAs for bargaining purposes, particularly in markets with more physician competition.

The analysis thus far has focused on some basic characteristics of hospitals or the general characteristics of the areas in which they operate. Results from previous analyses suggest that being in a city contributes to the decision to form an HPA, as does the area of the country in which the hospital is located. These factors suggest that geography matters -- possibly because one hospital's decision to enter an HPA may affect the next hospital's decision. Mark et al. (1996) found evidence of a "bandwagon effect" among hospitals in the same MSA. Using logistic regression analysis and cross-sectional survey data from 1993-94, they estimated that the adoption of a PHO by a hospital in an MSA

⁵¹ In some cases, such as New England, where 75% of hospitals had some form of HPA by 1994, the effect of region would be likely to disappear in the later periods just because so few hospitals remain. Other regions, however, experienced a similar effect even at a much lower initial HPA penetration rate (e.g., West North Central, 49%).

raised other MSA hospitals' probability of adoption by 33%. As shown in Model 1 in Table 2.6 below, this bandwagon effect appears to apply not only to PHOs, but also to IPAs and especially to ISMs. (The analysis is described in more detail below.)

These results say little, however, about the reasons for which hospitals in a given area are more likely to form an HPA. The possible reasons are difficult to disentangle: (1) hospitals in the same area face a similar set of (unobserved) market conditions, and therefore make similar decisions (the "market hypothesis"); (2) hospitals learn from other area hospitals about how to set up an HPA or the benefits of having one (the "learning hypothesis"), thus lowering the cost of adopting an HPA and increasing the probability of adoption; or (3) once a few hospitals decide to participate in HPAs, other hospitals feel the need to participate as well for competitive reasons (the "competition hypothesis"). This could be the case, for example, if a hospital establishes strong linkages with many area primary care practitioners, and other hospitals begin to fear losing admissions unless they take a similar action.

I will not try to separate the learning from the market hypothesis, but I will search for evidence of a competition effect in MSAs by attempting to distinguish the effect of MSA adoption of HPAs from the effect of competitor adoption of HPAs. The assumption is that most learning opportunities and market conditions affecting HPA adoption generally occur at the MSA level, but that if HPAs ever develop in response to competition, they are most likely to arise when geographically close competitors adopt HPAs. So, for example, expectations about future HMO enrollments or employer contracting might increase the probability of adoption across the MSA. On the other hand, physicians may only admit patients to the two or three closest hospitals, and not to

a hospital across town. In this case, a hospital may feel it necessary to form an HPA in response to a neighboring hospital's idiosyncratic decision to do so, even if it would not have otherwise, in order to protect market share.

To attempt to assess the effect of local HPA adoption on a hospital's decision to adopt, I have incorporated into the previously discussed hazard models variables for prior year HPA adoption by MSA hospitals and by competitor hospitals. The model therefore measures how previous MSA and competitor adoption affects a given urban hospital's adoption hazard rate, controlling for other hospital and market factors. Previous year MSA adoption is measured by the fraction of hospital beds in the MSA (excluding both the hospital itself and the hospital's system partners) associated with the HPA type. Local competitor adoption is calculated the same way, but includes only hospitals within 10 miles of the hospital in question. Because of the use of the prior year's values, hospitals that adopted in the first year of available data are excluded from the analyses.

Table 2.6
Hospital Adoption of Hospital-Physician Affiliations
Hazard ratios

	Low (94-98)	High (95-98)	Low-Integration		High-Integration	
			IPA (94-98)	PHO (94-98)	MSO (94-98)	ISM (95-98)
Model 1:						
Previous year MSA HPA penetration	1.134 (.141)	.859 (.136)	1.440* (.244)	1.463* (.190)	1.237 (.235)	1.605* (.293)
Model 2:						
Previous year MSA HPA penetration	.954 (.243)	.845 (.257)	1.248 (.365)	1.057 (.265)	1.048 (.297)	1.853 (.638)
Previous year competitor HPA pen.	1.256 (.255)	1.018 (.231)	1.283 (.277)	1.345 (.258)	1.263 (.268)	.947 (.259)
Model 3 (Using 94-98 data):						
Previous year MSA low HPA pen.	1.161 (.213)	.925 (.144)				
Previous year MSA high HPA pen.	1.008 (.188)	.875 (.142)				

* Statistically significant at $p < .05$ level. For Model 1, from left to right, number of hospitals included are 1237, 1008, 1549, 1617, 1799, 1642. For Model 2, they are 821, 643, 1071, 1131, 1229, 1147. For Model 3, they are 1,008 and 897.

Model 1 shows that the higher IPA penetration within a given area previously, the higher the hazard rate of IPA adoption. The same pattern applies to both PHOs and ISMs. The results indicate that hospital adoption decisions are geographically correlated, but give little insight into the reason for the correlation, i.e. whether the market, learning, or competition effect applies. Model 2 shows the effect of adding a competitor HPA penetration covariate. In all cases except one, the effect of previous year MSA penetration weakens (and becomes statistically insignificant), and the previous year competitor effect is of larger magnitude but is also statistically insignificant. The one exception is the ISM, the only HPA form for which prevalence continued to increase through 1998. Previous MSA ISM penetration continued to have a positive effect on the ISM adoption rate, statistically significant at the $p < .08$ level, while competitor ISM penetration had minimal effect.⁵²

At first glance, the behavior of close competitors seems to have had a bigger impact than overall MSA penetration on adoption hazard rates for PHO and MSO, so perhaps hospitals believe it is necessary to adopt these forms so that physicians feel as strongly affiliated with them as with their nearby competitors. (Hospitals may not feel compelled, however, to resort to ISMs, which involve a much higher level of integration than the other forms.) But given relatively large standard errors, this is at best a very weakly supported inference; there may simply not be enough variation to try to separate

⁵² I have also tried including MSA fixed effects in these regressions as a sort of direct measure of the "market" hypothesis -- that unobserved market conditions persist across years, uniformly raising or lowering adoption hazards. Doing so has a consistent effect across all models and all HPAs: While competitor coefficients remain statistically insignificant, the MSA penetration coefficients are all statistically significant, and generally hover in the .2 to .4 range. Perhaps this result simply means that given that an HPA has reached a high penetration level in an MSA, the remaining hospitals are unlikely to adopt. I prefer to omit fixed effects, using previous year MSA HPA penetration in part to capture the unobserved market factors associated with adoption.

competitive effects from MSA effects. In addition, it may be the case that markets are properly defined at a smaller radius than the MSA, in which case the positive coefficient is simply picking up the same otherwise unobserved market conditions that prompted the competitor to adopt the HPA form in the first place.⁵³ In general, the validity of this analysis is highly dependent on the assumption that competitive effects originate from a smaller radius than learning or market effects, and that sufficient data is available to identify these effects.

The third model is intended to test whether hospitals try to differentiate themselves from other hospitals by adopting a different form of HPA. In other words, once an MSA has reached a relatively high level of penetration of high-integration HPAs, will a hospital respond by adopting a low-integration HPA? The results for Model 3 suggest that the answer to this question is no. While hospitals may each try to offer differentiated products themselves (an approach explored in Section 2.6), they do not appear to try to differentiate themselves from other hospitals in the market.

2.5 Patterns of Hospital-Physician Affiliation Evolution

While Section 2.3 described the factors associated with the existence of HPAs, and Section 2.4 focused more closely on the characteristics associated with adoption, this section examines how hospital participation in HPAs has changed over time. Section 2.5 addresses two specific questions. First, have hospitals transitioned from low-integration to high-integration HPAs, or more particularly, from PHOs to ISMs? Second, what affects the number of HPA types in which a hospital participates?

⁵³ Endogeneity is a concern in this analysis, given the number of potentially omitted variables that can drive decisions to participate in HPA for all hospitals in a given area. The use of previous year MSA HPA adoption in a hazard model framework is meant to help address this problem.

2.5.1 Hospital-Physician Affiliation Transitions

As discussed previously, many comments in the trade literature have pointed to low-integration HPAs as being mere training tools for higher-integration versions. Descriptive statistics lend weak support to this contention, as the prevalence of PHOs has decreased in recent years (from 48% in urban hospitals in 1996 to 44% in 1998), while the prevalence of ISMs has increased slightly (from 27.5% in 1996 to 29% in 1998). Table 2.7 provides limited evidence that hospitals are more likely to enter low-integration HPAs (such as PHOs) before entering high-integration HPAs (such as ISMs), rather than vice versa. For example, 7% of hospitals adopted a PHO before adopting an ISM, while 4% of hospitals joined an ISM before joining a PHO.

Table 2.7
Order of Adoption of Low- vs. High-Integration Hospital-Physician Affiliations
1994-1998

	All Hospitals		Urban Hospitals	
	Low/ High	PHO/ ISM	Low/ High	PHO/ ISM
Never adopted either HPA	16.9%	36.1%	9.2%	26.6%
Adopted Low/PHO only	17.9	28.4	14.3	31.8
Adopted Low/PHO before High/ISM	11.5	7.2	14.1	9.7
Adopted High/ISM before Low/PHO	8.6	3.7	9.7	4.5
Adopted High/ISM only	17.9	15.6	14.0	14.0
Adopted HPAs simultaneously	27.3	9.0	38.7	13.5

The hazard model framework can provide further insight into whether there is any association between adoptions of high-integration HPAs, including ISMs, and prior adoptions of low-integration HPAs, or PHOs. Using data from 1995 through 1998, I tested separately whether hospitals that had previously adopted low-integration HPAs (at any time) were more likely to adopt high-integration HPAs, and whether hospitals that

had previously adopted PHOs were more likely to adopt ISMs.⁵⁴ In addition to the variables listed in Table 2.8 below, covariates include the full set of variables presented in Table 2.5. The first model includes a covariate indicating whether the hospital had previously adopted a low-integration HPA (or, alternatively, a PHO); for the urban hospital model, the first model also includes previous year ISM and PHO penetration for other hospitals in the MSA. The second model interacts the previous adoption variable with the year of the observation (not the year of the previous HPA adoption), for reasons explained below. The results for the variables of interest are as follows:

Table 2.8				
Hazard Analysis: Effect of Previous HPA Adoption on High-Integration HPA Adoption, 1995-1998				
	All Hospitals		Urban Hospitals	
	High	ISM	High	ISM
<u>Model 1</u>				
Previous Adoption of Low HPA (PHO)	1.105 (.073)	1.037 (.084)	1.139 (.105)	.984 (.103)
Prev. year MSA High (ISM) penetration			.876 (.142)	1.614* (.296)
Prev. year MSA Low (PHO) penetration			.905 (.142)	.939 (.166)
<u>Model 2</u>				
Previous Low HPA (PHO) * Year 1995	1.114 (.109)	1.456* (.198)	1.162 (.151)	1.253 (.217)
Previous Low HPA (PHO) * Year 96-98	1.099 (.095)	.891 (.085)	1.117 (.140)	.871 (.110)
Prev. year MSA High (ISM) penetration			.877 (.143)	1.621* (.298)
Prev. year MSA Low (PHO) penetration			.903 (.141)	.939 (.166)

*Statistically significant at $p < .05$ level. Standard errors reported in parentheses.

While few of the coefficients are statistically significant, they do present an interesting pattern. They suggest that having previously adopted a low-integration HPA may raise the adoption hazard rate for high-integration HPAs. This is particularly the

⁵⁴ I eliminated from the analysis 1994 observations and all observations of hospitals that adopted high-integration HPAs in 1994 (for the low-high HPA analysis), or alternatively all observations of hospitals that adopted ISMs in 1994 (for the PHO-ISM analysis).

case for ISMs early in the study period, when previously adopting a PHO raised the ISM adoption hazard by over 40%.

In each case, however, the effect of having a low-integration HPA in earlier years drops or disappears as time progresses. While low-integration HPAs may have been a precursor to higher-integration HPAs in early years, they are not in later years. So while PHOs may have served as learning tools for individual hospitals and their affiliated physicians in early years, they were not perceived as a necessary step for hospitals in later years. Perhaps this is because the "learning" process is not one that hospitals or physicians must personally experience. (Alternatively, perhaps physicians could have learned through affiliations with other hospitals. If this were the case, however, the previous year PHO penetration should have a positive effect on ISM adoption rates, which it does not.) Previous PHO or low-integration HPA participation may have helped hospitals to transition to ISMs or high-integration HPAs in the early period, but participation appears less important in the later period, especially for ISM formation. However, the lack of statistical significance of these results cautions against drawing a firm conclusion.⁵⁵

2.5.2 Number of Hospital-Physician Affiliations

Burns et al. (2000) used the measure of the number of HPA types in which a hospital participates as a measure of HPA formation in general. Finding that independent variables' impacts on whether a hospital has formed any HPA are similar to their impacts

⁵⁵ Adding MSA fixed effects to the urban hospital models increases several of the estimates for the effect of previous low HPA/PHO adoption to the 1.3 range, which is statistically significant. When fixed effects are included and previous MSA penetration variables are excluded, the estimates for previous low HPA adoption and previous low HPA adoption in 1995 become statistically significant at the $p < .05$ level, and the estimate for previous PHO adoption in 1995 is significant at the $p < .06$ level. However, even these results do not conclusively prove that low-integration HPAs spur the development of high-integration HPAs, since the hospital's idiosyncratic characteristics may facilitate the development of both.

on the number of HPA types in which a hospital participates, the authors suggest that hospitals may adopt menus of HPAs to appeal to varied physician preferences. But they do not assess whether the size of these menus has changed over time.

Empirically, the mean number of HPAs in which hospitals participate tracks the pattern of hospital participation in HPAs overall (see Table 2.1 above). In 1994, for all hospitals participating in at least one HPA, the mean number of HPA types was 1.82. This number rose to 2.00 in 1996, and then declined to 1.77 in 1998. (Means for urban hospitals are higher, but show the same pattern.) In percentage terms, the number of HPA types per participating hospital increased at a slower pace but then declined at a faster pace than the level of HPA participation overall. A rise in the mean number of HPAs is consistent with the diverse preference story, in combination with an increasing marginal cost of HPA participation -- it may be difficult to devote sufficient resources to establish multiple types of HPAs simultaneously, so hospitals take a couple of years to develop their full menus. But what theory would explain the fall in the number of HPA types?

There are several possible explanations. First, there may have been a change in hospital- or market-specific factors associated with the desire for multiple HPAs. Second, the extraneous HPAs may have achieved their goals and so were no longer necessary. For example, if their purpose were to change physician habits or to prepare physicians for more highly-integrated HPAs, perhaps habits changed or high-integration HPAs were formed and so previously existing HPAs could be dropped. Third, hospitals may have realized that the HPA forms were not achieving their goals, and then decided to discontinue these mistaken endeavors. Fourth, hospitals that first form an HPA later in

the study period may contribute to a reduction in the average number of HPA types per hospital, either because (a) they have not had the opportunity to develop multiple HPAs, (b) they have less interest in HPA diversity, or (c) they have learned enough from other hospitals' experiences to know which HPAs to target.

It is difficult to distinguish among all these possible scenarios. The explanation that some of the reduction is the result of purposeful transitioning from one form to another was at least partially explored in the earlier analysis. Another question that might be explored empirically is whether the number of affiliation types is a function only of the same characteristics that determine HPA participation generally, or whether it is also affected by the length of hospitals' experience in HPAs. It takes time for hospitals to achieve their goals, or to realize they cannot. A hospital's own previous experience with HPAs would then be inversely correlated with the number of HPAs in which they participate, at least once they get past the initial HPA-accumulation period. To examine this question, I used an OLS regression that included all urban hospitals that continuously participated in HPAs once they joined. The dependent variable was the number of HPA types in which they participated (1 through 7). The independent variables consisted of the standard variables in previous regressions, along with the percentage of MSA beds (other than the observation hospital) associated with any HPA, and the length of time since the hospital had initially formed the HPA. (The omitted category is hospitals that joined in the current year.)

The full results for the regressions summarized in Table 2.9 are reported in Appendix 2.C.3. The Appendix shows that few of the coefficient estimates in the hospital fixed effects equation are statistically significant, although the ones that are

significant can all be reasonably associated with a desire for diversity in HPA offerings: nonprofit status, local system membership, the number of HMOs in the area, physicians per capita. Because nonprofit hospitals may not be as focused on the bottom line as for-profit hospitals, they may be more likely to pursue multiple goals (including possibly catering to physicians with different needs), and therefore may choose to offer a fuller menu of affiliations. Local systems may include different hospitals with different needs, and therefore may choose to participate in multiple HPA types. If HPAs are formed in part to contract with HMOs, the more HMOs in the area, the more diversity in contracting needs. And finally, the more physicians per capita, the more likely there is diversity in physician interest in forming affiliations, all else equal.

Table 2.9
OLS Regression: Effect of Hospital and Market Characteristics on
Number of Hospital-Physician Affiliation Types in Which a Hospital Participates
Urban Hospitals, 1994-1998

	No Fixed Effects		Hospital Fixed Effects	
	Coefficient	SE	Coefficient	SE
% of MSA Beds Associated with HPAs	-.244*	.097	.111	.078
1995	-.124	.064	.097	.066
1996	-.111	.072	.147	.076
1997	-.521*	.091	-.090	.121
1998	-.701*	.105	-.234	.134
Initially formed HPA 1-2 years before	.283*	.052	.078	.061
Initially formed HPA 3-4 years before	.482*	.068	.093	.115

*Statistically significant at $p < .05$ level. Full results reported in Appendix 2.C.3.

But the nonprofit, system, HMO, and physician variables are not the only variables of interest. In this regression, the year dummy variables pick up the effect of initially joining an HPA, relative to initially joining an HPA in 1994. So, for example, according to the fixed effects regression, a hospital that initially joined an HPA in 1996 initially had more HPAs than a hospital that initially joined an HPA in 1994. A hospital that initially joined an HPA in 1998, on the other hand, had fewer HPAs on average than

a hospital that initially joined an HPA in 1994, a result statistically significant at the $p < .06$ level. This result is consistent with late-adopting hospitals' ability to learn from the past experience of other hospitals, and therefore to choose the HPAs that most closely match their needs. (Unfortunately, it is also consistent with late adopters having a lower taste for diversity, a taste not adequately captured by other included variables.) On the other hand, the positive coefficient on "the percentage of MSA beds associated with any HPA" belies a different learning hypothesis: that the more widespread HPAs in general, the more hospitals learn and therefore the fewer HPAs they have.

The "initially formed" variables would pick up any effects associated with longer experience with HPA participation. In other words, hospitals that have been participating in HPAs for a longer period of time may participate in slightly more HPA types than hospitals that have just joined HPAs. While this result is not statistically significant, it suggests that (at least for the five-year study period) hospitals do not necessarily reduce the size of their menu of HPA types as they gain experience with affiliations. Hospitals that choose menus of HPAs may therefore do so purposefully, to satisfy their own or their contracting partners' diverse needs. There is little evidence in these results for survival-of-the-fittest experimentation with contracting types.

2.6 Conclusions

This paper has examined the characteristics associated with organizational innovation in hospitals, in particular, the development of hospital-physician affiliations. It found, for example, that multihospital system members were generally more likely than independent hospitals to form any type of affiliations. This suggests that there may be economies of scale associated with the development of these, and presumably any future

organizational forms. It confirmed previous findings that HMO penetration had little effect, implying that the motivations for affiliations went beyond managed care contracting. It also found substantial variations in the attractiveness of HPA types to different types of hospitals. Teaching hospitals tend to avoid affiliating with MSOs, for example, while embracing ISMs -- precisely the opposite inclination of for-profit hospitals. Perhaps for-profit hospitals are more prepared to offer the business-related services characteristic of MSOs, while teaching hospitals are more intent on finding ways to maintain patient volume.

Several analyses focused on the ways that hospital organizations evolve over time. They found, for example, that the previous year prevalence of a particular organizational form in the hospital's geographic area is positively associated with a hospital's adoption of that form. The reasons for this phenomenon are unclear. Another analysis found that there is some evidence of evolution from low-integration to high-integration forms at the beginning of the study period, but that this trend disappeared over the study period. This may be because pioneering hospitals and physicians felt more comfortable with the less integrated form of organization, but their experiences were communicated to non-participating organizations in such a way that these organizations were able to form more high-integration affiliations without taking the intervening step.

This chapter has shown that there is tremendous variation in the characteristics of hospitals that adopt hospital-physician affiliations. Not just in the characteristics of hospitals that adopt *any* affiliation, or even low-integration or high-integration affiliations, but in the characteristics of hospitals that adopt each particular individual type of affiliation. This implies both that any given hospital perceives the potential costs

and benefits of each affiliation to be different, and that the hospitals themselves differ in their evaluations of the net benefits of these relationships. A deeper understanding of hospital-physician affiliations will require a better comprehension of why for-profit hospitals act so differently from other hospitals with respect to the establishment of physician-hospital organizations, for example. Further analysis of hospital-physician affiliations should wherever possible evaluate individual hospital-physician affiliations separately.

Health care payers have shown an interest in purchasing bundled services from physician and hospital providers, an approach that can be successful only if hospitals and physicians actively coordinate their work. While there is some evidence that the prevalence of hospital-physician affiliations has slightly declined over recent years, they remain widespread. It is important to understand how they grow and change, because they could conceivably affect the functioning of health care markets in the future.

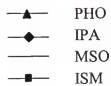
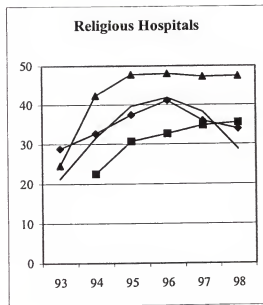
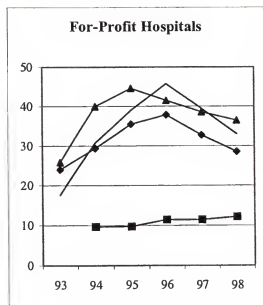
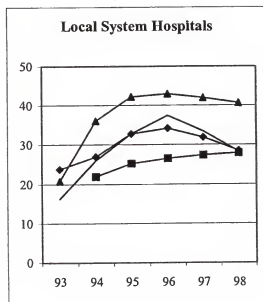
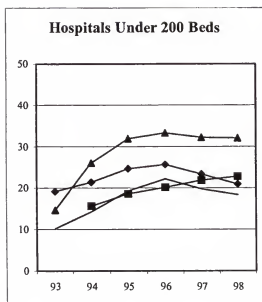
APPENDIX 2.A.1

Characteristics of Study Hospitals in 1994 and 1998				
Year	All Hospitals		Urban Hospitals	
	1994	1998	1994	1998
Nonfederal Medical-Surgical Hospitals	4,991	4,772	2,617	2,566
Percentage Responding to Survey	88%	83%	87%	79%
Hospitals in Study	4,233	3,795	2,311	1,956
Percentage of Hospitals That Are:				
For Profit	10.7	11.7	13.9	15.6
Governmental	27.6	27.1	14.8	13.4
Religious	12.0	11.7	15.8	16.0
Teaching	9.8	9.4	17.7	17.8
Under 100 Beds	61.0	65.6	36.8	41.6
100-200 Beds	21.4	20.8	32.3	33.1
200-300 Beds	10.7	8.3	18.3	15.2
300+ Beds	6.9	5.3	12.5	10.1
Local System	38.3	48.2	43.7	57.0
National System	34.3	39.2	35.3	40.5
Contract Managed	15.5	16.3	7.9	7.6
Mean Hospital Case Mix Index	1.25	1.26	1.37	1.40
Mean Hospital Occupancy	50.1	48.5	57.8	57.2
Percentage of Hospitals in Areas That Are:				
Rural	45.4	48.5		
Under 250k	9.4	9.0	17.2	17.5
250k to 1 million	16.8	16.6	30.7	32.2
More than 1 million	28.5	25.9	52.1	50.3
New England	4.5	4.4	6.1	6.0
Mid Atlantic	10.2	9.1	15.6	14.5
South Atlantic	14.7	14.5	15.8	15.8
East North Central	16.5	16.4	18.4	18.5
East South Central	8.3	8.6	5.7	5.8
West North Central	15.1	15.9	6.7	6.8
West South Central	14.0	15.1	13.1	14.2
Mountain	6.9	6.6	4.8	4.3
Pacific	9.8	9.4	13.9	13.9
Percentage of Hospitals in Areas with:				
Under 5% HMO penetration	23.3	9.1	18.8	7.0
5-15% HMO penetration	32.3	16.2	28.1	9.9
15-25% HMO penetration	27.7	29.5	27.0	19.8
25-35% HMO penetration	7.9	24.1	11.4	28.8
Over 35% HMO penetration	8.7	21.1	14.7	34.5
Area physicians per 1,000 population	1.8	1.9	2.5	2.8
Area beds per 1,000 population	2.6	2.3	2.3	1.9
Mean Number of HMOs in MSA			2.6	2.8

"Area" refers to county for rural hospitals, MSA for urban hospitals. HMO penetration is state-level HMO penetration for rural hospitals, and MSA penetration for urban hospitals.

APPENDIX 2.A.2

Hospital-Physician Affiliation Trends in Selected Hospital Types



APPENDIX 2.B.1

Probit Analysis Results: Marginal Effects						
Hospital & Market Characteristics Associated with Hospital Participation in Any, Low-Integration, and High-Integration Hospital-Physician Affiliations, 1994-98						
	Any	SE	Low	SE	High	SE
For Profit	-4.93*	1.35	-1.03	1.40	-7.13*	1.35
Governmental	-8.38*	.89	-10.87*	.95	-8.14*	0.94
Religious	5.81*	1.21	3.88*	1.32	4.05*	1.30
Teaching	3.79*	1.56	-3.43*	1.52	6.17*	1.53
100-200 Beds	8.44*	.98	10.22*	1.12	7.99*	1.12
200-300 Beds	12.38*	1.34	13.31*	1.61	12.26*	1.62
300+ Beds	10.42*	1.88	11.74*	2.14	14.01*	2.14
Local System	9.36*	.91	6.91*	.98	13.62*	0.96
National System	-1.28	1.10	1.64	1.16	-0.63	1.15
Contract Managed	-4.03*	1.05	-3.77*	1.15	-6.55*	1.12
Case Mix Index	.2076*	.0234	.1915*	.0242	.1623*	.0240
Previous Year Occupancy	.0817*	.0212	.0841*	.0214	.0560*	.0211
1995	6.48*	.96	6.89*	1.14	6.33*	1.13
1996	8.37*	.96	8.29*	1.15	8.88*	1.15
1997	7.10*	.99	6.43*	1.18	5.68*	1.18
1998	7.21*	1.03	6.09*	1.23	4.05*	1.22
5-15% HMO penetration	0.02	1.10	0.89	1.24	1.99	1.23
15-25% HMO penetration	0.44	1.18	-0.02	1.32	3.97*	1.31
25-35% HMO penetration	-1.51	1.32	-0.51	1.45	0.27	1.44
Over 35% HMO penetration	-4.65*	1.65	-4.25*	1.68	-0.44	1.68
MSA Under 250k	1.94	1.37	2.98*	1.51	2.63	1.52
MSA 250k to 1 million	6.90*	1.12	8.24*	1.27	9.13*	1.28
MSA over 1 million	8.99*	1.22	17.09*	1.32	10.01*	1.36
New England	14.23*	1.53	15.94*	2.00	10.26*	2.06
Mid Atlantic	-2.48	1.55	1.43	1.61	-7.98*	1.54
East North Central	3.29*	1.24	3.06*	1.39	6.07*	1.38
East South Central	-5.96*	1.52	-2.43	1.61	-5.92*	1.59
West North Central	7.16*	1.19	1.53	1.45	10.41*	1.43
West South Central	7.48*	1.15	1.32*	1.36	3.17*	1.39
Mountain	11.24*	1.32	10.27*	1.74	12.29*	1.74
Pacific	9.04*	1.39	9.48*	1.67	5.60*	1.68
Physicians per 1,000	.0199*	.0044	.0090*	.0042	.0136*	.0043
Beds per 1,000	-.0095*	.0027	-.0179*	.0033	-.0055	.0031
Number of observations	20,859		20,830		20,859	
Pseudo R2	.1205		.1151		.0978	

* Statistically significant at p<.05 level. Omitted categories are nonprofit, nongovernmental, non-religious, non-teaching, under 100 beds, non-local system, non-national system, non-contract managed, under 5% penetration, rural area, and South Atlantic region.

APPENDIX 2.B.2

OLS Analysis with Hospital Fixed Effects						
Hospital & Market Characteristics Associated with Hospital Participation in Any, Low-Integration, and High-Integration Hospital-Physician Affiliations, 1994-98						
	Any	SE	Low	SE	High	SE
For Profit	-4.99	3.10	-8.32*	3.19	-3.17	3.45
Governmental	-6.10*	2.94	-4.10	2.82	-4.74	2.77
Religious	7.42*	2.70	5.18	2.88	8.29*	3.23
Teaching	-1.50	2.13	-2.25	2.23	4.30	2.66
100-200 Beds	0.51	1.51	0.52	1.59	-2.01	1.73
200-300 Beds	2.83	2.19	1.03	2.36	0.85	2.63
300+ Beds	-0.89	2.80	-2.80	3.16	-0.91	3.82
Local System	6.62*	1.34	6.70*	1.37	7.56*	1.51
National System	-0.32	1.63	1.30	1.66	-2.23	1.79
Contract Managed	-0.58	1.84	0.36	1.72	-1.30	1.78
Case Mix Index	.0194	.0514	-4.45	.0485	.0462	.0501
Previous Year Occupancy	.0187	.0162	-0.59	.0187	.0002	.0158
1995	6.40*	.75	6.40*	.72	5.80*	.76
1996	8.20*	.81	8.01*	.78	8.10*	.82
1997	6.96*	.96	6.54*	.91	5.35*	.95
1998	6.37*	1.14	5.37*	1.08	3.63*	1.13
5-15% HMO penetration	2.32	1.25	1.41	1.21	1.54	1.30
15-25% HMO penetration	2.74	1.54	1.70	1.50	2.21	1.64
25-35% HMO penetration	2.98	1.81	2.35	1.78	0.12	1.95
Over 35% HMO penetration	1.36	2.16	1.00	2.11	-1.81	2.33
Physicians per 1,000	.0069	.0283	.0009	.0263	.0459	.0273
Beds per 1,000	.0014	.0076	.0012	.0069	.0010	.0069
Number of Observations	20,859		20,830		20,859	
R-Square	.6876		.7382		.6869	

* Statistically significant at $p < .05$ level. Dummy variable coefficients and robust standard errors reported in percentage points.

APPENDIX 2.B.3

Urban Hospital Participation in Hospital-Physician Affiliations, 1994-1998							
Probit Analysis with MSA Fixed Effects: Marginal Effects							
	Any	Low	High	IPA	PHO	MSO	ISM
For Profit	-6.65* (1.68)	-5.18* (1.97)	-10.84* (1.98)	3.57 (1.97)	-9.97* (1.99)	2.60 (1.89)	-13.85* (1.40)
Governmental	-7.00* (1.52)	-22.28* (1.81)	-8.75* (1.81)	-1.62* (1.55)	-18.53* (1.70)	-18.57* (1.40)	4.48* (1.68)
Religious	5.97* (1.26)	7.70* (1.69)	4.01* (1.76)	8.84* (1.79)	2.17 (1.83)	4.20* (1.71)	-0.28 (1.50)
Teaching	2.37 (1.37)	-4.00* (1.76)	5.29* (1.71)	-4.17* (1.62)	-2.05 (1.75)	-6.09* (1.52)	7.10* (1.54)
100-200 Beds	5.77* (1.03)	6.44* (1.40)	8.49* (1.41)	1.98 (1.47)	6.64* (1.53)	9.06* (1.45)	3.46* (1.37)
200-300 Beds	8.08* (1.25)	9.64* (1.83)	13.25* (1.82)	2.78 (2.00)	8.94* (2.07)	9.50* (2.01)	6.80* (1.93)
300+ Beds	7.89* (1.57)	10.94* (2.27)	16.09* (2.25)	7.12* (2.61)	10.87* (2.64)	12.22* (2.59)	10.99* (2.52)
Local System	6.41* (1.05)	5.78* (1.31)	16.20* (1.30)	3.93* (1.30)	6.42* (1.35)	15.90* (1.24)	9.67* (1.12)
National System	1.38 (1.27)	3.17* (1.59)	2.10 (1.63)	3.53* (1.59)	5.08* (1.68)	-0.38 (1.54)	2.01 (1.43)
Contract Managed	-4.14* (1.69)	-4.95* (2.12)	-8.11* (2.16)	-3.82 (2.19)	-10.44* (2.17)	-7.47* (2.00)	-6.60* (1.74)
Case Mix Index	.1335* (.0249)	.1550* (.0314)	.1298* (.0315)	.1488* (.0313)	.0920* (.0331)	.1820* (.0301)	.0183 (.0280)
Previous Year Occupancy	.1041* (.0296)	.1405* (.0391)	.0600 (.0325)	-.0058 (.0329)	.2191* (.0417)	.0689* (.0329)	.1332* (.0350)

(Continued on next page)

APPENDIX 2.B.3, continued

Urban Hospital Participation in Hospital-Physician Affiliations, continued							
	Any	Low	High	IPA	PHO	MSO	ISM
1995	3.07* (1.31)	5.21* (1.76)	5.37* (1.81)	3.72 (1.92)	5.75* (1.98)	7.42* (1.91)	3.68* (1.80)
1996	3.71 (1.56)	5.64* (2.11)	7.51* (2.16)	4.32 (2.32)	5.96* (2.40)	11.84* (2.33)	5.66* (2.21)
1997	0.21 (2.09)	1.07 (2.69)	0.98 (2.76)	-0.11 (2.80)	0.23 (2.98)	3.50 (2.79)	6.48* (2.79)
1998	-4.03 (2.78)	-2.84 (3.36)	-5.32 (3.44)	-5.54 (3.30)	-4.22 (3.62)	-3.20 (3.25)	7.75* (3.49)
5-15% HMO penetration	3.53 (2.03)	1.19 (2.99)	4.04 (2.97)	0.11 (3.33)	3.40 (3.47)	-0.16 (3.21)	2.44 (2.96)
15-25% HMO penetration	3.66 (2.40)	3.22 (3.34)	3.65 (3.38)	1.20 (3.71)	3.18 (3.83)	4.20 (3.67)	1.59 (3.21)
25-35% HMO penetration	5.87* (2.53)	6.37 (3.71)	3.73 (3.86)	4.57 (4.28)	7.57 (4.35)	1.87 (4.16)	-0.47 (3.56)
Over 35% HMO penetration	5.30 (2.97)	4.95 (4.22)	1.15 (4.41)	2.03 (4.72)	4.92 (4.85)	1.57 (4.65)	-2.03 (3.94)
# HMOs in MSA	.0029 (.0017)	.0024 (.0022)	.0039 (.0022)	.0046* (.0020)	.0011 (.0022)	-.0024 (.0020)	.0096* (.0018)
Physicians per 1,000	.1879* (.0679)	.1493 (.0868)	.1982* (.0892)	.1418 (.0924)	.2069* (.0940)	.1730* (.0863)	.0209 (.0840)
Beds per 1,000	-.0438 (.0289)	-.0407 (.0374)	-.0491 (.0382)	-.0482 (.0415)	-.0299 (.0404)	-.0391 (.0373)	.0005 (.0353)
Number of observations	10,389	10,708	10,869	10,158	10,480	10,344	10,237
Pseudo R2	.1672	.1704	.1441	.1741	.1764	.1619	.1693

* Statistically significant at $p < .05$ level. Coefficients for dummy variables reported in percentage points. Standard errors in parentheses.

APPENDIX 2.C.1

Hazard Model: Hospital Adoption of Hospital-Physician Affiliations							
Hazard ratios							
	Any	Low	High	IPA	PHO	MSO	ISM
For Profit	.987 (.066)	1.090 (.078)	.893 (.067)	1.094 (.095)	1.043 (.087)	1.318* (.116)	.619* (.073)
Governmental	.825* (.039)	.743* (.039)	.798* (.044)	.740* (.049)	.689* (.044)	.591* (.049)	.850* (.062)
Religious	1.094 (.063)	1.165* (.073)	1.088 (.069)	1.208* (.089)	1.137 (.081)	1.212* (.094)	1.021 (.086)
Teaching	1.015 (.068)	.857* (.062)	1.089 (.077)	.898 (.076)	.861 (.069)	.829* (.072)	1.411* (.124)
100-200 Beds	1.153* (.061)	1.243* (.072)	1.147* (.067)	1.165* (.080)	1.283* (.085)	1.298* (.094)	1.207* (.097)
200-300 Beds	1.166* (.084)	1.291* (.101)	1.219* (.096)	1.118 (.105)	1.377* (.122)	1.312* (.128)	1.226 (.133)
300+ Beds	1.155 (.109)	1.338* (.134)	1.207 (.124)	1.206 (.143)	1.408* (.159)	1.442* (.175)	1.334* (.181)
Local System	1.177* (.053)	1.124* (.057)	1.380* (.070)	1.143* (.070)	1.163* (.067)	1.604* (.103)	1.399* (.094)
National System	.950 (.051)	.958 (.057)	.987 (.059)	.909 (.065)	1.033 (.071)	.997 (.075)	.950 (.077)
Contract Managed	.972 (.054)	.996 (.063)	.872 (.057)	.915 (.073)	.978 (.074)	.797* (.077)	.829* (.076)
Case Mix Index	1.362* (.362)	1.472* (.177)	1.432* (.179)	1.286 (.186)	1.523* (.214)	2.040* (.289)	1.132 (.195)
Previous Year Occupancy	1.213 (.145)	1.163 (.159)	1.132* (.131)	1.083 (.175)	1.257 (.157)	1.091 (.183)	1.249 (.155)
1994		.791 (.459)		.735 (.525)	.906 (.702)	1.845 (1.395)	
1995	.969 (.493)	1.565 (.796)	.823 (.479)	1.203 (.815)	2.306 (1.371)	1.556 (1.072)	1.110 (1.045)
1996	1.437 (.707)	.901 (.612)	1.621 (.848)	.969 (.733)	1.438 (1.150)	3.507* (2.204)	2.371 (1.717)
1997	.616 (.620)	.225 (.260)	.938 (.949)	.171 (.247)	.272 (.443)	1.988 (1.979)	.598 (.918)
1998	.988 (.380)	1.166 (.508)	1.047 (.475)	.841 (.516)	.973 (.586)	1.308 (.769)	1.252 (.923)

APPENDIX 2.C.1, continued

	Hazard Model, continued						
	Any	Low	High	IPA	PHO	MSO	ISM
5-15% HMO penetration	1.003 (.054)	.950 (.057)	1.034 (.064)	.963 (.073)	1.002 (.071)	1.010 (.086)	1.212* (.107)
15-25% HMO penetration	.989 (.058)	.967 (.063)	1.049 (.070)	.944 (.077)	1.035 (.079)	1.054 (.096)	1.321* (.122)
25-35% HMO penetration	.971 (.070)	.938 (.073)	1.017 (.081)	.992 (.093)	.982 (.090)	1.034 (.109)	1.222 (.130)
Over 35% HMO penetration	.914 (.074)	.940 (.080)	.967 (.087)	.972 (.098)	.836 (.087)	.886 (.100)	1.189 (.145)
MSA Under 250k	1.068 (.077)	1.105 (.090)	1.205* (.097)	.942 (.100)	1.228* (.114)	1.509* (.166)	1.267* (.139)
MSA 250k to 1 million	1.170* (.071)	1.301* (.088)	1.315* (.090)	1.272* (.109)	1.369* (.107)	1.701* (.158)	1.444* (.135)
MSA over 1 million	1.157* (.073)	1.540* (.108)	1.313* (.094)	1.831* (.162)	1.410* (.115)	1.880* (.181)	1.322* (.135)
New England	1.195 (.112)	1.386* (.138)	1.088 (.114)	1.747* (.210)	1.357* (.150)	1.071 (.145)	1.484* (.193)
Mid Atlantic	.985 (.072)	.993 (.078)	.882 (.072)	1.265* (.121)	.921 (.082)	.921 (.095)	.850 (.093)
East North Central	1.031 (.066)	1.124 (.082)	1.059 (.075)	1.201 (.112)	1.137 (.091)	1.087 (.101)	1.223* (.114)
East South Central	.872 (.068)	.967 (.090)	.749* (.069)	1.086 (.131)	.864 (.096)	1.089 (.132)	.604* (.084)
West North Central	1.047 (.072)	1.010 (.078)	1.099 (.084)	1.062 (.106)	1.037 (.093)	.865 (.094)	1.481* (.147)
West South Central	1.106 (.073)	1.259* (.089)	.951 (.072)	1.250* (.114)	1.384* (.110)	1.242* (.114)	.762* (.084)
Mountain	1.279* (.104)	1.342* (.121)	1.215* (.112)	1.962* (.212)	1.149 (.121)	1.000 (.130)	1.234 (.156)
Pacific	1.173* (.093)	1.262* (.104)	1.058 (.094)	2.101* (.204)	.539* (.058)	1.043 (.113)	.686* (.091)
Physicians per 1,000	1.032 (.019)	1.002 (.021)	1.028 (.021)	.978 (.028)	1.053* (.024)	1.030 (.027)	.982 (.028)
Beds per 1,000	.986 (.015)	.967 (.018)	.990 (.018)	.999 (.023)	.897* (.022)	.938* (.029)	1.044 (.024)
Number of hospitals	4,217	4,062	4,217	4,062	4,062	4,062	4,217

* Statistically significant at $p < .05$ level. Standard errors in parentheses.

APPENDIX 2.C.2

Characteristics Associated with HPA Adopters, 1994 v. 1995-1998				
Probit Analysis: Marginal Effects				
	1994		1995-1998	
	dF/dx	SE	DF/dx	SE
For Profit	-2.35	3.18	-.31	2.63
Governmental	-8.10*	2.06	-5.29*	1.51
Religious	7.37*	2.78	4.61	3.03
Teaching	3.23	3.58	1.76	4.21
100-200 Beds	10.22*	2.31	3.50	2.40
200-300 Beds	11.41*	3.14	7.84	4.43
300+ Beds	14.70*	4.08	3.93	6.02
Local System	9.61*	2.15	6.26*	2.01
National System	-1.86	2.61	-4.03	2.10
Contract Managed	-2.27	2.46	-.93	1.88
Case Mix Index	.2107*	.0586	.0992*	.0488
Previous Year Occupancy	.0643	.0582	.0641	.0375
1996			-6.03*	1.45
1997			-10.18*	1.46
1998			-8.04*	1.64
5-15% HMO penetration	-.36	2.32	1.62	2.10
15-25% HMO penetration	-3.62	2.59	2.81	2.31
25-35% HMO penetration	.65	3.63	-2.29	2.34
Over 35% HMO penetration	-5.86	4.15	-2.73	2.97
MSA Under 250k	1.60	3.21	1.26	2.76
MSA 250k to 1 million	11.75*	2.53	-.19	2.46
MSA over 1 million	14.04*	2.75	-1.97	2.56
New England	18.14*	3.53	-1.61	4.16
Mid Atlantic	-2.10	3.48	.49	3.05
East North Central	1.30	2.96	2.31	2.58
East South Central	-6.73	3.51	-2.80	2.43
West North Central	8.21*	2.87	-.48	2.39
West South Central	9.98*	2.78	-.11	2.43
Mountain	15.50*	3.07	9.23*	3.83
Pacific	15.76*	3.15	-.48	3.41
Physicians per 1,000	.0090	.0100	.0167*	.0084
Beds per 1,000	-.0072	.0064	-.0014	.0046
Number of Observations	4,233		4,248	
Pseudo R2	.1208		.0525	

APPENDIX 2.C.3

OLS Regression: Effect of Hospital and Market Characteristics on
Number of Hospital-Physician Affiliation Types in Which a Hospital Participates
Urban Hospitals, 1994-1998

	No Fixed Effects		Hospital Fixed Effects	
	Coefficient	SE	Coefficient	SE
For Profit	-.202*	.048	-.259*	.104
Governmental	-.541*	.047	-.118	.129
Religious	.109*	.041	.065	.090
Teaching	-.093*	.040	-.001	.068
100-200 Beds	.064	.036	-.005	.054
200-300 Beds	.088	.048	-.019	.076
300+ Beds	.303*	.060	.040	.103
Local System	.414*	.031	.236*	.047
National System	.013	.038	-.055	.061
Contract Managed	-.232*	.056	-.019	.082
Case Mix Index	.315*	.080	-.087	.186
Previous Year Occupancy	.244*	.099	-.060	.118
5-15% HMO penetration	.017	.080	-.003	.059
15-25% HMO penetration	.092	.089	.062	.066
25-35% HMO penetration	.100	.101	.060	.074
Over 35% HMO penetration	-.026	.113	-.051	.083
# HMOs in MSA	.011*	.005	.035*	.013
Physicians per 1,000	.629	.223	.598*	.168
Beds per 1,000	-.033	.092	.063	.070
% of MSA Beds Associated with	-.244*	.097	.111	.078
1995	-.124	.064	.097	.066
1996	-.111	.072	.147	.076
1997	-.521*	.091	-.090	.121
1998	-.701*	.105	-.234	.134
Initially formed HPA 1-2 years	.283*	.052	.078	.061
Initially formed HPA 3-4 years	.482*	.068	.093	.115
Number of observations	8,179		8,179	
R-Squared	.2309		.7103	

3 The Relationship Between Hospital-Physician Affiliations and Treatments, Expenditures, and Outcomes for Medicare Patients with Acute Myocardial Infarction

As explained in Chapter 2 of this dissertation, new types of formally structured hospital-physician affiliations (HPAs) diffused rapidly across the United States in the 1990s.⁵⁶ The potential positive impacts of HPAs (from hospitals' points of view) can be classified into four broad categories: generating admissions, increasing bargaining power, controlling costs, and improving the quality of care. For example, HPAs might facilitate hospitals' ability to win managed care contracts, enhance their capacity to contract directly with employers, and strengthen physician loyalty, all of which would contribute to the generation or retention of hospital admissions (and revenues). If they control a sufficient number of beds and/or physicians, they may be able to raise prices or stem the growth of managed care.

At the same time, HPAs could conceivably implement financial incentives, utilization review, and information sharing mechanisms, which could both control health care costs and improve health care quality. According to a 1994 Ernst & Young study, hospitals' main objectives in forming one type of affiliation were to improve relations with physicians, to share financial risk, and to raise the quality of care. But whether these relationships actually have achieved these goals is another question. In order to craft appropriate policies in areas such as antitrust enforcement, it is important to understand how HPAs affect the prices, costs, and the quality of care. Toward this end, this chapter will examine how hospital-physician affiliations affect the treatments, treatment

⁵⁶ For a description of these hospital-physician affiliation types, see Section 2.1.1. They include hospital-sponsored independent practice associations (IPAs), physician-hospital organizations (PHOs), group practices without walls (GPWWs), management services organizations (MSOs), foundations (MFs),

expenditures, and health outcomes of Medicare patients who have experienced a heart attack.

3.1 Literature Review

Previous literature, such as Simpson & Coate (1998), describes in general terms the potential benefits of vertical integration between hospitals and physicians.⁵⁷ First, when a hospital and physician are closely integrated, perhaps through a financial arrangement that guarantees that each will reap a benefit from the other's prosperity, each party has an incentive to ensure that the other provides high quality care. If a physician perceives quality lapses in the provision of hospital care, the physician will have an incentive to improve the care so that the hospital (or the hospital and physician as a single unit) can continue to attract patients. In the same way, if a hospital perceives that a physician's care for patients is at a low level of quality, it can take steps to improve the care or terminate its relationship with the physician. If there were no relationship between the physician and hospital, there would be few financial incentives for this sort of mutual monitoring, as long as patients could distinguish the quality of care given by each provider. Also, regardless of financial incentives, physicians and hospitals seeking high-quality care for their patients may find it less costly to improve the quality of care of their partner if they have some role in its management or administration.

Hospital affiliations with physicians may result in more efficient provision of hospital care, a second potential benefit of an HPA. Hospitals can use contractual affiliations to align physician incentives with hospital incentives. Physicians make use of

equity models, and integrated salary models (ISMs). IPAs and PHOs are considered "low-integration" HPAs, while the other types are classified as "high-integration" HPAs.

⁵⁷ See also Goes & Zhan (1995), Haas-Wilson & Gaynor (1998), Conrad (1988), and Robinson (1997) for discussion of the potential effects of vertical integration.

hospital resources in treating their patients. It is theoretically possible that by giving physicians a financial stake in the provision of hospital services, an HPA can provide incentives to improve efficiency of inpatient treatment. For example, physicians may share in hospital risk pools (Kohn (2000)). But even if physicians do not benefit directly financially from improved efficiency, the increased physician involvement in hospital affairs that may arise in the presence of closer contractual or employment ties may increase physicians' attentiveness to the needs of the hospital. In general, the additional security a formal affiliation provides would encourage physicians to make more hospital-specific investments than they would otherwise. If affiliations result in physicians concentrating referrals to a single hospital, hospitals can more easily assess practice patterns and encourage physicians to adhere to treatment protocols.

The impacts of these relationships are likely to depend not only on the type of arrangement involved, but also on the precise details of the arrangement. Some hospital-physician organizations are more focused on cost control than others. For example, according to the Ernst & Young survey, more than 77% of PHOs with more than 12,000 covered lives had some sort of utilization management system in place, which could help monitor and control the cost of care. Yet many PHOs did not track even basic utilization indicators such as hospital average length of stay. Other PHOs choose to control costs through restricting membership to those physicians willing to actively control costs. But while half of PHOs reported restricting membership, fewer than half of these "closed" PHOs used economic credentialing to choose their members.

While it is clear that affiliations could potentially benefit patients, it is unclear whether they have realized their potential. Empirical studies are needed to measure the

net effects of these arrangements. Many past empirical studies of hospital-physician affiliations have become dated, and many focus on HPAs' effects on hospital costs and margins.⁵⁸ For example, Alexander & Morrissey (1988), using 1982 American Hospital Association (AHA) data, found that greater administrative participation by physicians and a higher percentage of physicians on salary were related to higher hospital costs per discharge. Goes & Zhan (1995), studying California hospitals between 1984 and 1990, found that integration strategies had little effect on operating margins, but that financial integration was associated with lower operating costs. Both of these studies predate many of the organizational structures that pervade the industry today. In a more recent study, Mark et al. (1998) found that offering management services to physicians had no statistically significant impact on average Medicare costs or total margin. The results of a first-differenced version of the model, however, implied that the adoption of such services was associated with a statistically significant decline in average costs.

There have been even fewer studies of the effects of hospital-physician integration on patient treatment and outcomes. Shortell & LoGerfo (1981) explored the effects of medical staff organization on the quality of care for patients who had had an acute myocardial infarction (AMI). They used 1973 data on 50,000 AMI cases in 95 hospitals. The dependent variable in their regressions was a "standardized mortality ratio," a measure of the number of expected versus actual deaths, where the expected deaths statistic was a function of the patients' age and blood pressure readings. They found that the degree to which physicians concentrated their professional activity at one hospital had a statistically insignificant impact on mortality, but that the medical staff president's participation on the hospital board was associated with lower mortality. In

⁵⁸ Snail & Robinson (1998) provide an excellent review and critique of many of these articles.

addition, the authors regressed mortality ratios on a variable measuring physician participation in hospital decision making; here too they found that physician participation was associated with lower mortality. Finally, Shortell & LoGerfo examined the quality of care for patients who had had appendectomies. They found that the percentage of normal tissue removed (an indicator of poor quality of care) was statistically significantly negatively related to the degree to which physicians concentrated their professional activity at one hospital, and the percentage of active staff physicians on contract, both factors that might be associated with HPAs. These findings suggest that physician involvement in hospital affairs may indeed affect patients.

There do not appear to be any empirical studies that examine the effects of the modern forms of hospital-physician affiliations. Given the prevalence of HPAs, as documented in Chapter 2, it is important that we gain a better understanding of their effects on patients. As described previously, they have the potential both to improve the quality of patient care and to reduce the cost of providing care. But they may ultimately have neither effect. Management difficulties may prevent HPAs from functioning as intended, or HPAs may involve too few physicians to have a substantial impact.⁵⁹ A number of studies, such as Burns et al. (2001) and Burns et al. (1998), have suggested that HPAs have served more as vehicles for contracting with managed care organizations, than as vehicles for integrating clinical activities. Kohn (2000) also distinguishes between HPAs' potential and their reality. She explains that HPAs have the potential to provide a continuum of care, and to create the infrastructure for tracking costs and

⁵⁹ In 1998, for example, the American Hospital Association Survey inquired about the number of physicians involved in hospital-based HPAs. The median IPA involved 100 physicians, but other types involved far fewer. It seems that a large fraction of the hospitals reporting HPAs include very few physicians in these arrangements. For example, nearly half of the hospitals reporting physician

outcomes of care. Through extensive case studies, she found some examples of physician-hospital organizations (PHOs) that accepted full risk from health plans, played a significant role in hospital quality assurance activities, and shared in hospital savings. But she also discovered that many PHOs were much more loosely organized. Although hospital-physician affiliations have the potential to improve quality and control costs, only empirical analysis can reveal whether they have actually realized this potential.

Kohn notes that it is unclear whether HPAs are formed to manage financial incentives, or to blunt these incentives by forming larger organizations that can resist change. The bulk of hospital participants' efforts may be directed not toward the improvement of efficiency or quality, but instead toward the preservation of financial stability through the generation of hospital admissions and/or an increase in market power. Simpson & Coate (1998) present multiple theories of how affiliations might harm competition. For example, vertically integrating hospitals could raise rivals' costs by controlling a large proportion of admissions in a geographic area, leaving too few admissions for other hospitals to reach their minimum efficient scale. The authors ultimately discount the possibility that integration strategies could result in competitive harm, but such harm cannot be ruled out. If a small number of hospitals are able to affiliate with a large share of physicians through the purchase of physician practices, or through other means, they can decrease competition in both the hospital and the physician services markets and potentially raise prices.

Even if the effort to capture market share eventually proves unsuccessful, this sort of behavior can generate affiliation formation across the hospital market. This may occur

membership in PHOs report having five physicians or fewer; of the remaining hospitals, however, the median size was over 100 physicians.

even if hospitals doubt the potential benefits of the arrangements from a patient care or treatment cost perspective. One executive has said that purchasing physician practices is “not an optimal strategy. It’s a defensive move.” Another executive, commenting on practice acquisitions in the Philadelphia area, explained that “most of the deals are being driven by a worry that if we don’t do it, someone else will. The feeling is: ‘I may suffer from doing acquisitions, but at least I’ll stay in the game. If I don’t do them, I may not survive.’”⁶⁰ The Antitrust Division of the Department of Justice has noted that PHOs can use market power in either the hospital or physician market to raise prices or decrease quality, or to restrict consumer health plan choice. The Division has settled three suits against PHOs that allegedly involved no financial or other substantial integration among physicians.⁶¹

Prior literature has discussed both the theoretical advantages and disadvantages of modern hospital-physician affiliations, but has not tested them empirically. Due to a lack of appropriate data, this chapter will not examine hospital costs, prices, or health plan choice. It will, however, test whether hospital-physician affiliations have had any effects on patient treatments or outcomes. If the analyses reveal that the organizations have had some impact on patient treatment, then these organizations are doing more than just facilitating administrative aspects of managed care contracting or increasing bargaining power. And if there is any evidence of improved outcomes, it should be considered in an assessment of the potential net effects of hospital-physician affiliations.

⁶⁰ Both quotes are from Anders (1997).

⁶¹ The challenged PHOs tended to involve a very high proportion of an area’s providers. For example, one challenged PHO joined the only Danbury, Connecticut hospital, with 98% of area physicians. For more details on the Danbury case, see *U.S. and State of Connecticut v. Healthcare Partners, Inc.*, 1996-1 Trade Cas. (CCH) 71,337 (D. Conn. 1996). For a discussion of all three cases, see Department of Justice, Antitrust Division, “Health Care Task Force Recent Enforcement Actions,” April 15, 1999.

3.2 Data

To test the effects of affiliations on the treatment of patients, this chapter combines the data and approaches used in the first two dissertation chapters. The patient data analyzed in Chapter 1 is the basis of this chapter's analysis as well. Patients included in the dataset are Medicare enrollees between the ages of 65 and 99 who were admitted to a study hospital between 1994 and 1998 as a result of a heart attack. In this chapter, study hospitals consist of nonprofit, for-profit, or local government general medical-surgical hospitals for which all relevant regressors are present.⁶² Patients admitted to hospitals that did not respond to the American Hospital Association survey are therefore generally excluded from the analysis (unless the variables could be interpolated using the criteria described in Chapter 2).

The hospital variables incorporated into this chapter's analyses are largely those used in Chapter 2. For example, the hospital-physician affiliation variables originate from the AHA database, and have been coded as described in Chapter 2. Hospital size, for-profit status, religious affiliation, contract management, teaching status, managed care market penetration variables, and physicians per 1,000 people are also the same variables used in Chapter 2. On the other hand, this chapter implements the system identifier coding methodology created for Chapter 1, with one exception. It collapses the "medium" and "big" hospital sizes, reducing the number of hospital system categories from nine to six. Table 3.1 presents descriptive statistics for the broadest set of this chapter's study hospitals.

⁶² Local government hospitals had been excluded in Chapter 1, in order to focus on the systems in which nongovernmental hospitals participate. They are now included.

Table 3.1
Hospital Characteristics in Selected Study Years

	1994	1996	1998
Number of nonfederal general surgical hospitals	4,991	4,888	4,772
Number of study hospitals matched to patients	4,226	4,169	3,650
% with independent practice associations (IPAs)	23.5	28.0	23.8
% with physician-hospital organizations (PHOs)	30.3	37.6	35.7
% with low-integration hospital-physician affiliations	44.2	51.7	49.6
% with management services organizations (MSOs)	17.7	26.2	21.3
% with integrated service models (ISMs)	17.8	22.7	24.8
% with medical foundations	13.9	15.3	8.6
% with equity models	2.7	4.0	3.0
% with group practices without walls (GPWWs)	7.3	8.3	5.4
% with high-integration hospital-physician affiliations	41.3	50.0	45.3
% with any hospital-physician affiliations	61.7	70.2	68.7
Of hospitals with fewer than 100 beds			
% in local systems with no big partners	22.8	25.6	26.2
% in local systems with big partners	13.2	14.7	17.1
% in systems with no local partners	6.5	6.5	6.3
Of hospitals with more than 100 beds			
% in local systems with no big partners	26.3	29.8	30.9
% in local systems with big partners	16.7	21.0	27.2
% in systems with no local partners	6.8	6.1	4.9
% Under 100 beds	59.8	63.1	64.3
% 100-250 beds	28.7	27.6	26.8
% Over 250 beds (big)	11.5	9.3	8.9
% For profit	10.8	11.7	11.8
% Local government	26.7	27.3	26.1
% Religious	12.3	11.7	12.0
% Contract managed	15.4	15.5	15.8
% Teaching	10.2	10.3	9.7
Physicians per 1,000 in hospital area	1.80	1.90	1.96
% with <5% HMO penetration in MSA or state (if rural)	23.4	15.8	8.5
% with 5-15% HMO penetration	32.1	25.6	15.9
% with 15-25% HMO penetration	27.9	23.9	29.5
% with 25-35% HMO penetration	7.9	19.5	24.5
% with over 35% HMO penetration	8.7	15.3	21.5

Patient demographic variables included among the regressors in this chapter's analyses are sex, race (black or non-black), age, and interactions of these variables. The dependent variables include a number of those used in Chapter 1, such as catheterization within 90 days of initial admission, revascularization (angioplasty (PTCA) or bypass surgery (CABG)) within 90 days, log 90-day Medicare expenditures (in 1993 dollars),

and 90-day mortality. In addition, this chapter considers whether the patient is readmitted to the hospital for treatment of AMI between 30 and 90 days after his or her initial admission. This variable is meant to capture subsequent heart attacks, rather than any continuation of treatment which may occur within 30 days of the initial admission. Table 3.2 describes the characteristics of study patients.

Table 3.2
Patient Characteristics in Selected Study Years

	1994	1996	1998
Number of study patients	210,742	210,208	174,796
% Initially admitted to hosp. with a hospital-physician affiliation	74.3	82.9	80.7
% Female	48.6	50.0	50.8
% Black	5.9	6.0	6.0
% Age 65 to 69	21.0	19.6	18.0
% Age 70 to 74	23.7	23.2	21.8
% Age 75 to 79	21.4	22.0	22.3
% Age 80 to 89	29.0	29.8	31.6
% Age 90 to 99	5.0	5.3	6.4
% Receiving catheter within 90 days of AMI	45.4	48.5	50.3
% Receiving PTCA or CABG within 90 days of AMI	31.5	35.2	37.5
Mean Medicare hospital payments within 90 days of AMI	14,202	16,118	17,067
% Readmitted with an AMI within 90 days of initial AMI	1.8	1.9	2.0
% Dying within 90 days of initial AMI	24.4	24.4	24.4

3.3 Hospital-Physician Affiliations & Patient Treatment

3.3.1 Patient Treatments, Expenditures & Outcomes

The regression framework for the initial set of regressions is identical to that used in Chapter 1. There are five sets of regressions, one for each of the five dependent variables. Within each set of regressions are three different models: one that includes an indicator for "any" affiliation, one that breaks this variable into separate indicators for "low-" and "high-integration" affiliations, and one that includes all seven HPA types individually. All regressions include hospital characteristics, patient fixed effects, hospital fixed effects, and year fixed effects. An observation is a Medicare beneficiary i

admitted to a general medical-surgical hospital j in the United States for treatment of AMI in year t . The form of the regression is therefore:

$$Y_{it} = \text{Hospital-Physician Affiliation Variable(s)} * \alpha_{it} + \text{Hospital Traits} * \beta_{it} + \text{Patient Traits} * \gamma_i + \text{Hospital Fixed Effects} * \delta_j + \text{Year Fixed Effects} * \chi_t + \epsilon_{it}$$

If this regression were to exclude hospital fixed effects (but in their place include regional dummy variables and MSA size variables), the impact of having a hospital-physician affiliation would appear substantial. An affiliation on average is associated with more intensive and costly treatment. According to this analysis, a patient initially admitted to a hospital involved in an affiliation with physicians is nearly two percentage points more likely to receive a catheterization relative to a patient admitted to an unaffiliated hospital. At the same time, patients may experience very slightly improved outcomes:

Table 3.3 OLS Analysis Without Fixed Effects					
	Catheter Within 90 Days	PTCA or CABG Within 90 Days	Log 90-Day Inpatient Payments	AMI Readmit Within 90 Days	90-Day Mortality
Any	1.82 (.40)	1.31 (.33)	2.46 (.56)	-.08 (.04)	-.15 (.16)

When fixed effects are included, so that the impacts of affiliations are identified based on hospitals moving into or out of affiliations, the results weaken substantially. But as shown in Table 3.4, there is still evidence that specific types of affiliations may affect the treatment of patients. Dependent variables for the five sets of regressions are listed across the top of the table, and independent variables (in each of the three separate models) are listed down the side. Coefficients and standard errors are reported in percentage points. More complete results for Model 3 are reported in Appendix 3.A.

Table 3.4
OLS Analysis: The Effect of Hospital-Physician Affiliations on
AMI Patient Treatments, Payments, and Outcomes, 1994-98

	Indep. Variable: Affiliation Type	Catheter Within 90 Days	PTCA or CABG Within 90 Days	Log 90-Day Inpatient Payments	AMI Readmit Within 90 Days	90-Day Mortality
Model 1	Any	.14 (.19)	.13 (.18)	.36 (.29)	-.10 (.06)	.33 (.18)
Model 2	Low	-.05 (.18)	.13 (.18)	.02 (.28)	-.06 (.06)	.13 (.17)
	High	.17 (.16)	.09 (.15)	.39 (.24)	-.07 (.05)	.12 (.15)
Model 3	IPA	.26 (.19)	.44 ^b (.19)	.39 (.29)	-.02 (.06)	-.04 (.18)
	PHO	.03 (.19)	.22 (.19)	-.03 (.30)	-.05 (.06)	-.13 (.18)
	MSO	-.22 (.17)	-.21 (.17)	-.49 (.27)	-.12 ^b (.05)	.13 (.16)
	ISM	.67 ^a (.18)	.61 ^a (.18)	.88 ^a (.28)	.07 (.06)	.07 (.17)
	Foundation	.30 (.21)	.32 (.21)	.63 (.33)	-.10 (.06)	.20 (.20)
	Equity	.06 (.32)	-.29 (.32)	-.14 (.51)	.14 (.10)	.07 (.30)
	GPWW	-.11 (.26)	.14 (.26)	-.34 (.40)	-.10 (.08)	-.10 (.24)

Notes: Coefficients and robust standard errors (in parentheses) reported in terms of percentage points. For a fuller version of model 3, see Appendix 3.A.

^a Significant at $p < .01$ level; ^b Significant at $p < .05$ level.

These results suggest that the impact of hospital-physician affiliations can vary in accordance with HPA type. The strongest results are for the ISM, the presence of which is associated with higher-intensity treatments and higher Medicare expenditures. IPAs and the foundation model appear to share this pattern, although their impacts do not for the most part reach the level of statistical significance. There is also one, but only one, statistically significant impact of HPAs on health outcomes: the presence of an MSO is associated with a very small reduction in the probability of readmission for an AMI.

Variations on these models, reported in Appendix 3.B, generally reinforce their results. When the regression analysis is extended to include 1993 (and treats hospitals as if they did not have ISMs, equity models, or GPWWs in 1993, a year for which data on these models is unavailable), both ISMs and PHOs appear to be associated with higher intensity treatment. MSOs are still associated with lower readmission rates, and there is an additional statistically significant health outcome: PHOs are associated with slightly lower 90-day mortality. Restricting the regression analysis to include only urban hospital data for 1994 through 1998, I find that ISMs and foundations are associated with higher intensity treatments and treatment expenditures, but not differences in outcomes. In general, these analyses suggest that if HPAs have any effect at all, it is to increase the intensity and costliness of medical treatment, with little impact on health outcome measures.

3.3.2 Identification & Endogeneity Issues

As discussed in Chapter 1, the inclusion of hospital fixed effects is intended to account for unobserved factors that affect hospitals throughout the study period. For example, hospital fixed effects would absorb the impact of having a consistently more severely ill set of patients. The use of fixed effects means that the effect of hospital-physician affiliations is measured not through differences between hospitals that adopt affiliations and those that do not, but through differences between the period in which an individual hospital has an affiliation, and the period in which it does not. In other words, the identification strategy depends on hospital movement into and out of hospital-physician affiliations. In the 1994 through 1998 data on which Table 3.4 is based, 31.9% of hospitals joined or left "any" affiliations. More specifically, 22.9% of hospitals went

from having no affiliation to having at least one, and 16.2% went from having an affiliation to having none (percentages which sum to greater than 31.9% because some hospitals did both). Overall, 30.4% of hospitals joined or left low-integration HPAs affiliations, 35.8% joined or left high-integration HPAs, 25.0% joined or left PHOs, and 22.8% joined or left ISMs.

Although using an identification strategy based on changes in affiliation status helps to control selection problems, it does not eliminate them. It is the hospitals on a decision-making margin that are most likely to move into and out of affiliations, and these hospitals must in some way differ from hospitals not at the margin. This is apparent in Chapter 2, which discussed some of the factors associated with joining a hospital-physician affiliation. While the inclusion of regressors such as hospital size helps control for some of these factors, these regressors cannot capture all variation in characteristics associated with decisions to join or leave affiliations. The estimates in the Table 3.4 regressions become biased when differences in decisions to join or leave HPAs are associated with differences in treatment intensity or outcomes.

As shown in Table 3.5 below, it is certainly true that hospitals that join, leave, remain in, or remain out of HPAs differ from one another. For-profit hospitals tend to be over-represented among affiliation-leavers. Government hospitals and small hospitals are over-represented among the joiners and leavers of "any" affiliation, but under-represented among joiners and leavers of the individual HPA types presented here. System hospitals are under-represented among "any" hospital joiners and leavers, but over-represented among the leavers of PHOs and ISMs. Hospitals that join or leave low-integration HPAs have a disproportionately high percentage of black patients, while hospitals that join or

leave high-integration HPAs have a disproportionately low percentage. Hospitals that never join affiliations have a disproportionate share of older patients. While Table 3.5 shows that some characteristics differ by affiliation status, the patterns are for the most part not consistent across affiliation types.

Table 3.5
1996 Characteristics of Hospitals that Joined or Left Affiliations
or Remained In or Out of Affiliations, 1994-98

HPA Type	Status	Percent of hospitals that are:					Percent of patients who are:		
		For Profit	Govt.	Relig.	<100 Beds	Local System	Female	Black	Age 70-74
Any	Joined	10.5	32.2	9.7	71.6	39.1	50.0	5.8	22.9
	Left	13.2	31.6	9.4	71.2	41.6	50.3	6.7	23.2
	Always in	12.6	18.1	15.7	48.9	51.8	50.0	6.0	23.5
	Never in	9.2	45.9	4.8	87.4	31.4	50.3	5.6	21.8
Low	Joined	10.2	28.6	11.3	65.8	43.1	50.1	6.2	23.3
	Left	15.4	28.9	11.6	65.0	46.1	50.3	6.6	23.4
	Always in	14.6	12.6	16.7	42.9	53.7	50.1	5.8	23.3
	Never in	8.1	39.9	7.1	79.7	35.9	49.8	6.1	22.8
High	Joined	13.4	24.1	11.1	61.0	44.3	49.9	5.6	23.0
	Left	13.1	24.6	13.3	60.8	47.4	50.0	5.9	23.3
	Always in	10.6	16.8	17.7	46.8	55.6	49.9	6.5	23.7
	Never in	10.3	39.8	6.3	79.0	32.4	50.3	5.5	22.4
PHO	Joined	10.5	23.8	11.9	59.9	44.6	50.5	6.2	23.5
	Left	17.2	21.8	13.2	57.0	51.0	50.1	6.5	23.3
	Always in	13.9	12.6	16.8	41.7	54.5	49.9	5.7	23.6
	Never in	10.1	35.6	9.1	74.1	39.2	49.9	6.2	22.8
ISM	Joined	8.9	21.2	15.7	55.1	45.8	49.7	6.1	23.6
	Left	12.9	20.9	14.5	47.7	52.9	50.1	6.5	23.6
	Always in	3.6	22.3	15.4	50.4	53.8	49.5	6.6	23.7
	Never in	13.8	30.5	9.5	69.0	41.1	50.2	5.7	22.9
All		11.7	27.3	11.7	63.1	44.2	50.0	6.0	23.2

In addition, the fact that hospitals that join and leave affiliations have different characteristics does not necessarily mean that they treat their patients differently. One way to take a closer look at the potential endogeneity issue is to compare the intensity and outcomes variables for "joiners" and "leavers" to those of hospitals that neither joined nor left affiliations. To be included in the analysis presented below in Table 3.6, a hospital must have been included in the Table 3.4 analysis for both 1994 and 1998.

"Joiners" are defined as hospitals that did not have the particular type of affiliation in 1994, but did in 1998; "leavers" are defined as those that had an affiliation in 1994, but not in 1998. Table 3.6 shows a few consistent differences among hospitals with different affiliation statuses. For example, patients initially admitted to hospitals that always had affiliations were disproportionately likely to receive procedures and to survive 90 days, while patients of permanently unaffiliated hospitals were disproportionately unlikely to receive procedures or to survive 90 days.

Table 3.6
Patient-Weighted Comparison of Hospitals that Joined or Left Affiliations
Between 1994 and 1998
And Hospitals that Remained In or Out of Affiliations

Hospital Participation in Affiliations		Hosps	PTCA or CABG Within 90 Days			90-Day Mortality		
Type	Status		1994	1998	Change	1994	1998	Change
Any	Joined	604	29.3	35.6	21.5	25.0	24.7	-1.2
	Left	341	30.1	35.5	17.9	24.9	25.3	1.5
	In 94 & 98	1683	32.8	39.1	19.1	24.0	24.0	0.0
	Out 94 & 98	687	25.2	31.5	25.3	26.1	25.6	-1.9
Low	Joined	579	30.5	36.4	19.3	24.9	24.9	-0.2
	Left	354	31.8	37.7	18.7	24.7	25.0	1.4
	In 94 & 98	1076	33.0	39.1	18.7	23.7	23.9	1.0
	Out 94 & 98	1306	28.3	35.0	23.5	25.3	24.5	-3.1
High	Joined	591	32.3	38.7	19.7	23.9	24.1	0.7
	Left	419	31.8	36.4	14.5	24.3	24.8	2.0
	In 94 & 98	922	33.9	40.5	19.2	24.0	23.7	-1.1
	Out 94 & 98	1383	26.8	33.2	23.7	25.4	25.2	-0.9
PHO	Joined	495	31.0	37.2	20.0	24.7	24.9	0.8
	Left	283	32.9	37.6	14.3	24.1	24.5	1.7
	In 94 & 98	711	33.1	39.5	19.3	23.6	23.6	-0.1
	Out 94 & 98	1826	29.3	35.7	22.0	25.1	24.8	-1.3
ISM	Joined	464	33.6	40.3	19.9	23.8	23.8	0.0
	Left	206	34.8	39.4	13.4	23.9	23.7	-0.8
	In 94 & 98	367	34.2	41.0	19.8	23.5	23.4	-0.3
	Out 94 & 98	2278	29.3	35.4	20.9	24.9	24.9	-0.3

Table 3.6 also offers an opportunity to compare trends within hospital types across time. First, statistics for hospitals that were not in an affiliation in 1994 but that had joined an affiliation by 1998 ("joined") can be compared to hospitals that never

joined an affiliation ("out 94 & 98"). In the case of angioplasties and bypass surgeries, hospitals that later joined an affiliation (of whatever kind) were in 1994 already providing more procedures than their unaffiliated counterparts. Perhaps due to the effect of joining affiliations, or perhaps due to a "catch-up" phenomenon on the part of hospitals that remained unaffiliated, procedure rates grew more slowly for hospitals that joined affiliations between 1994 and 1998 than for those that remained independent.

If changes in procedure rates were viewed in percentage points, rather than as a percentage of the initial starting value, there are only two substantial disparities in the increases between the two groups. Hospitals that never joined low-integration HPAs experienced a growth in procedure rates 0.8 percentage points higher than hospitals that joined low-integration HPAs. This evidence suggests that joining HPAs is associated with a lower growth in procedure rates. On the other hand, hospitals that joined ISMs experienced increases in procedure rates 0.6 percentage points higher than hospitals that never joined.

A second possible comparison is between hospitals that left an affiliation between 1994 and 1998 ("left") and hospitals that never left an affiliation ("in 94 & 98"). The 1994 starting values tended to be closer together, but for all affiliation types presented except ISMs, hospitals that eventually left HPAs tended to have lower procedure rates than hospitals that remained in HPAs. Despite this lower base, they also had lower percentage growth rates than hospitals that remained in HPAs. In other words, leaving an HPA tends to be associated with lower growth in procedure rates, a finding in tension with most of the evidence from affiliation-joiners (where joining an HPA is associated with lower growth in procedure rates).

This is not so much the case for ISMs, however, where at least in terms of percentage points, affiliation-joiners experienced faster growth in procedure rates than unaffiliated hospitals. This finding would then be reinforced by the results of system-leavers. These results may therefore be reflected in the fact that in Table 3.4, of the five models presented here, only the ISM model had a statistically significant (and positive) effect on procedure rates.

As mentioned previously, mortality rates tended to be highest for unaffiliated hospitals and lowest for hospitals that always participated in an affiliation. Convergence may therefore explain why unaffiliated hospitals tended to experience the greatest (or almost the greatest) percentage point decline in mortality between 1994 and 1998. It may also help to explain why the same discrepancy between affiliation-joiners and affiliation-leavers is visible in mortality rates as was visible in procedure rates. In each case, hospitals that remained unaffiliated experienced a faster decline in mortality rates relative to hospitals that joined affiliations, implying that participation in an affiliation is associated with worse outcomes. On the other hand, hospitals that left affiliations tended to experience increases in mortality rates, while hospitals that remained in affiliations experienced lower increases or decreases, implying that participation in an affiliation is associated with better outcomes. The experiences of system-joiners and system-leavers may therefore cancel each other out, resulting in the no-net-affiliation-effect result shown in Table 3.4.⁶³

The differences among hospital types visible in Table 3.6 indicate that the results in Table 3.4 should be interpreted with caution. There may be unaccounted-for factors

that affect both the likelihood that a hospital will affiliate, and the tendency of hospitals to practice high-intensity medicine. For example, hospitals eager to be on the forefront of medicine may also seek to be on the forefront of hospital management. Or perhaps physicians and hospitals both form affiliations and change practice styles in anticipation of the arrival of managed care. In either case, there will be a correlation between the affiliation variables in the ordinary least squares equation, and the error term. This will produce biased estimates of the affiliation coefficients.

While the use of hospital fixed effects and other hospital regressors in the Table 3.4 regressions may eliminate some of the discrepancies visible in Table 3.6, other hospital traits associated with affiliation formation may remain unobserved and bias the regression results. To test for the endogeneity of the affiliation variables, I used a Durbin-Wu-Hausman test. First, I regressed the presence of the affiliation types (any, low, high) on hospital and market traits, hospital fixed effects, and year affects, in a regression modeled after those in Chapter 2. I then included the residuals from this regression in a regression similar to the ones presented in Table 3.4. The results revealed no evidence that the use of the "any" affiliation variable produced inconsistent estimates. Nor was there evidence of endogeneity in the readmission or mortality regressions. However, the test results did suggest the presence of inconsistency in one set of ordinary least squares results: the estimates for the high-integration affiliation variable in the catheterization, PTCA/CABG, and log payment regressions.

To address this problem, I used an instrumental variables technique that takes full advantage of the information provided by Chapter 2's predicted affiliation equations.

⁶³ The ISM is again an exception to the two-opposing-effects rule, since mortality improved least for system joiners and most for system-leavers. Unlike the procedure rate example, however, the ISM

Mechanically speaking, I first removed hospital means from all variables to account for fixed effects. I then constructed instrumental variables versions of the Model 2 procedure and expenditure regressions reported in Table 3.4. The indicator variables for low- and high-integration HPAs were instrumented by all of the exogenous variables in the Table 3.4 analyses, along with three variables present in the affiliation equations from Chapter 2 but not in the patient outcome equations: case mix index, hospital beds per capita, and previous occupancy. I would expect case mix index to affect the probability that a hospital affiliates because the more complex the tasks of the hospital, the more important that the hospital cooperate with physicians to address their diverse needs and to control costs. A hospital in an area with more beds per capita may face more pressure to affiliate as hospitals compete over admissions. Finally, a hospital with lower occupancy rates may turn to affiliates as a way to fill beds. While some might argue that these variables could be included directly in the patient treatment and outcome regressions (e.g., hospitals with low occupancy rates might encourage more intensive treatment of patients), a counterargument would be that these variables ultimately affect patients through their effects on hospital relationships with physicians.⁶⁴

The results of the instrumental variable analysis (reported in Appendix 3.C) suggest that hospital-physician affiliations may be associated with a more intensive practice style. In other words, heart attack patients initially admitted to hospitals engaged in either low-integration or high-integration affiliations with physicians are more likely to

impact on mortality rates was not statistically significant in Table 3.4.

⁶⁴ If case mix index is thought to proxy for a desire or ability to provide highly intensive treatments, it could conceivably be included in the patient treatment and outcomes regressions. If case mix index is included in the patient-level regression, and therefore cannot serve as an instrumental variable, the estimates of "any" change only slightly relative to the results reported in Table 3.5. The six statistically significant Model 2 results decrease somewhat in magnitude (for example, the 1.55 log expenditure

receive catheterizations and revascularization procedures (PTCAs/CABGs), and incur higher inpatient expenditures, than patients initially admitted to hospitals without these types of affiliations.⁶⁵ The coefficient estimates in these analyses, however, are quite large; it may be that the instrumental variables used are too few, or have too little explanatory power in the presence of hospital fixed effects, to serve as adequate instruments.

In a second examination of the endogeneity issue, I created an instrumental variable analysis using data from urban hospitals only. "Any", "Low," and "High"-integration affiliation variables were instrumented using (1) the percentage of beds in other hospitals in the MSA that are located in religious hospitals, and (2) the percentage of beds located in system-affiliated hospitals. Both religious status and system status were shown in the previous chapter to be associated with the adoption of hospital-physician affiliations, and (as discussed in Chapter 2) information externalities may lead hospitals to adopt when nearby hospitals adopt. In this case, religious and system statuses of neighboring hospitals would be correlated with a hospital's decision to affiliate; these characteristics would not likely affect individual patient outcomes at the hospital in question, however. If these assertions are correct, these variables are appropriately used as instrumental variables. These results of this instrumental variable analysis, consistent with the original ordinary least squares estimates, indicate that hospital-physician affiliations have little effect.

estimate for low-integration affiliations becomes .92); three are no longer statistically significant at the $p < .05$ level. But in general, the results are quite similar to those reported in Table 3.5.

⁶⁵ A similar analysis that instruments only for high-integration HPAs suggest that high-integration HPAs contribute to more intensive treatment practices, but that low-integration HPAs contribute to less intensive treatment practices.

3.3.3 Inpatient, Outpatient & Physician Treatment Expenditures

The previous analyses have considered only the effects of hospital-physician affiliations on inpatient hospital care. But affiliations could conceivably affect both physician and outpatient care as well. For example, if an affiliation enables a hospital and physician group to jointly contract for care on a capitated basis not just for hospital services, but also for physician and outpatient services, then physicians will have an incentive to provide more efficient outpatient care. In addition, hospital partnerships that improve physician access to data or other management services may help improve both the efficiency and quality of care. Affiliations may therefore reduce expenditures for outpatient or physician care. On the other hand, just as previous analyses suggested that affiliations may be associated with higher-intensity treatment, affiliations may drive up physician and outpatient expenditures.

To examine this possibility, I used inpatient, outpatient, and physician claims data from 1993 through 1997. I performed the same ordinary least squares analysis presented in Table 3.4, except that the variables that include physician data are based on a 5% sample of AMI patients. (Full outpatient data is currently available for AMI patients in the 1993 through 1995 cohorts, and a 20% sample is available for 1996 and 1997. Due to the large number of claims, physician data is available only for a 5% sample of patients between 1993 and 1997. No data is yet available for 1998.⁶⁶) Weighted average hospital, outpatient, and physician expenditures within 90 days of initial admission for the AMI patients in the 5% sample totaled \$18,883 (in 1993 dollars). Weighted average

⁶⁶ The current unavailability of 1998 claims also will reduce the total expenditures for the 1997 AMI cohort, as 90 days' worth of claims will not be available for patients admitted near the end of 1997. Outpatient costs were calculated as the sum of the provider payment amount, coinsurance, and deductible. Physician claims are from the physician/supplier file; costs were calculated from accepted claims only, and

expenditures for all patients with available data were \$15,192 for hospital care, \$420 for outpatient care, and \$3,209 for physician care. Thus, while inpatient treatment expenditures dwarf all other short-term expenditures for AMI patients, physician expenditures in particular make up a significant portion of expenditures for patient care.

The use of 1993 through 1997 data, combined with the use of outpatient and physician data, generates slightly stronger expenditures results than those presented previously.⁶⁷ The OLS results reported below in Table 3.7 suggest that low-integration HPAs may be contributing to higher treatment expenditures for Medicare heart attack victims. Total payments made by or on behalf of patients initially admitted to hospitals participating in low-integration affiliations were approximately two percentage points higher than payments for patients initially admitted to hospitals without low-integration affiliations. This result was statistically significant at the $p < .07$ level, and appears mainly to be associated with the formation of PHOs.

consist of the allowed amount for providers who accept Medicare assignment, or the minimum of submitted charges and 1.0925 times the allowed charge for those who do not.

⁶⁷ ISM, equity model, and GPWW variables were not present in 1993, affecting the coding of these variables as well as the high-integration and any-HPA variables. In this table, hospitals are treated as if they did not participate in these forms in 1993. Revising this analysis to include only 1994 through 1997 data, or revising it to treat all hospitals that had these models in 1994 as if they also had them in 1993, changes only a few results. Both supplemental analyses create positive and nearly significant coefficients on log 90-day inpatient payments for ISMs. The 1994 through 1998 analysis amplifies the negative coefficient on "high" for log outpatient and physician payments to the point of statistical significance. It also weakens the PHO and low-HPA results. Recoding the 1993 variables increases the coefficient on "any" in the log outpatient and physician payments analysis to a statistically significant level, and the "any" coefficient in the total payments analysis to a nearly statistically significant level.

Table 3.7				
OLS Analysis: The Effect of Hospital-Physician Affiliations on AMI Patient Inpatient, Outpatient, and Physician Payments, 1993-97				
	Independent Variable: Affiliation Type	Log 90-Day Inpatient Payments	Log 90-Day Outpatient & Physician Payments	Log 90-Day Total Payments
Model 1	Any	.42 (.24)	1.73 (1.73)	1.08 (1.10)
Model 2	Low	.29 (.24)	3.30 (1.71)	2.01 (1.09)
	High	-.23 (.22)	-1.75 (1.58)	-1.19 (1.01)
Model 3	IPA	.20 (.26)	-2.41 (1.83)	-.81 (1.17)
	PHO	.43 (.25)	4.46 ^b (1.80)	3.54 ^a (1.15)
	MSO	-.33 (.26)	-.09 (1.78)	-.50 (1.14)
	ISM	-.13 (.27)	-.96 (1.91)	-1.04 (1.21)
	Foundation	-.08 (.30)	-3.45 (2.09)	-1.19 (1.33)
	Equity	-.69 (.49)	.61 (3.44)	1.78 (2.19)
	GPWW	-.42 (.38)	-.35 (2.67)	.33 (1.70)
N Model 1		1,035,482	51,786	51,441
N Model 2		1,032,507	51,653	51,310
N Model 3		1,003,532	50,189	49,858

Notes: Coefficients and standard errors (in parentheses) reported in percentage points. Regressions include hospital fixed effects and all non-HPA regressors listed in Appendix 3.A.
^aSignificant at p<.01 level; ^b Significant at p<.05 level.

The ordinary least squares results in Tables 3.4 and 3.7 suggest that hospital-physician affiliations do little to reduce total expenditures for the treatment of Medicare heart attack patients. In fact, it seems that if HPAs have any financial effect at all, it is to increase total expenditures.⁶⁸

⁶⁸ As in previous analyses, endogeneity is a possible problem. An instrumental variable analysis suggests that high-integration HPAs may be associated with lower inpatient expenditures, the opposite of the result previously reported.

3.4 Variations in Affiliations' Effects by Hospital or Market Type

The effects of hospital-physician affiliations on patient treatments, treatment expenditures, and outcomes may be augmented or diminished by various hospital or market characteristics. This section expands on previous analyses by testing the interactions between affiliations and several of these characteristics.

Profit status. As Conrad et al. (1988) point out, nonprofit hospitals may be more likely to have a multiplicity of objectives than for-profit hospitals, which are expected to focus on maximizing profits. In this case, the formation of HPAs may have a particularly strong effect on nonprofit hospitals relative to for-profit hospitals, since HPAs can provide a vehicle through which the parties focus on common goals. On the other hand, the formation of HPAs may not eradicate conflicting goals, in which case for-profit hospitals may find it easier to implement management routines or treatment protocols that ultimately affect patient treatment. Empirical analysis is necessary to determine whether for-profit or nonprofit status is more conducive to the operation of HPAs that influence patient care.

A regression that interacts variables indicating whether a hospital is engaged in a hospital-physician affiliation with whether the hospital is for-profit or not-for-profit (including governmental, religious, or secular nonprofit) can answer this question. Other than interacting the affiliation variable with profit status, the OLS equation presented in Table 3.8 is the same equation for which results were presented in Table 3.4. (Table 3.8 presents the results of this analysis ("Model 1"), along with the results for the analyses below.)

The estimates suggest that participation in affiliations has the same effect for both for-profit and not-for-profit hospitals: close to none. There is, however, one exception. The results imply that patients in for-profit hospitals with affiliations experience slightly higher mortality rates than patients in for-profit hospitals without affiliations. It is not clear why affiliated for-profit hospitals should experience worse mortality rates. Note, however, that the sum of the any/for-profit interaction term and the for-profit term does not differ significantly from zero. In other words, the mortality experience of for-profit hospitals with affiliations is not significantly worse than the mortality experience of not-for-profit hospitals.

Managed care. It may be the case that the more pervasive managed care in the market, the more likely a substantial number of patients will be covered by capitation contracts. HPAs that have substantial numbers of patients covered by capitation contracts would seem to have an incentive to coordinate behavior and take other steps to control costs. If this is the case, HPAs in higher-managed care penetration market areas would have more impact than HPAs in lower-penetration market areas. To examine this hypothesis, I interacted a variable indicating the existence of an HPA with an indicator for whether the area had a significant presence of managed care enrollees (over 15% of area residents).

This interaction between an indicator for affiliations and the level of HMO penetration yielded two statistically significant results. First, in a setting with relatively low managed care penetration, the presence of hospital-physician affiliations is associated with a slightly greater tendency to provide angioplasties or bypass surgeries. (Based on more detailed regression analysis, the effect appears to originate from low-

integration affiliations.) But when HMO penetration reaches relatively high levels, this effect disappears. One potential explanation for this pattern is that hospitals may be able to encourage more intensive practice styles through affiliations, but that this growth in procedure rates is curtailed by the spread of managed care.

The second result is that in high managed care penetration areas, affiliations are associated with slightly higher mortality rates. According to supplementary regressions, the slightly higher mortality rates among hospitals in high-HMO penetration areas are associated with low-integration HPAs. The procedure variables were not statistically significant and so cannot explain the mortality result. Endogeneity problems may contribute to the mortality finding. In addition, the coefficient diminishes to the point of statistical insignificance when the analysis includes only urban hospitals, hospitals for which local, as opposed to statewide, managed care penetration rates are available.

Provider bargaining power. The more physicians per capita in a given geographic area, the more leverage hospitals will have relative to an individual physician. Hospitals can afford to be selective in choosing the physicians with whom they form affiliations. They may also be able to construct HPAs where they retain a significant amount of influence. In either case, the HPAs formed may be more effective in changing physician-decisionmaker behavior relative to a case where physicians are able to retain more independence. If hospitals involved in HPAs are indeed interested in changing physician behavior, affiliations in markets with more physicians may have a stronger impact than otherwise similar affiliations would have in other markets. This hypothesis can be tested through interactions between HPA status and physicians per capita.

As shown in Table 3.8, the results for this analysis were generally statistically insignificant. A high level of physicians per capita does seem to be associated with more intensive practice styles, a result consistent with previous literature finding "induced demand" for medical procedures in areas with high numbers of physicians. However, the presence of an affiliation neither augments nor diminishes this impact.

Table 3.8
OLS Analysis:
Variations in Any Hospital-Physician Affiliation Effects
By Selected Hospital and Market Traits, 1994-98

Model	Indep. Variable: Affiliation Type	Catheter Within 90 Days	PTCA or CABG Within 90 Days	Log 90-Day Payments	AMI Readmit Within 90 Days	90-Day Mortality
	1					
1	Any*Non Profit	.16 (.20)	.15 (.19)	.36 (.31)	-.09 (.06)	.19 (.19)
	Any*For Profit	-.03 (.56)	-.03 (.55)	.32 (.87)	-.21 (.17)	1.50 ^a (.55)
	For Profit	.74 (.81)	.82 (.80)	4.03 ^a (1.25)	.38 (.25)	-1.29 (.79)
2	Any*Low HMO Penetration	.45 (.27)	.58 ^b (.26)	.65 (.41)	-.16 (.08)	.01 (.26)
	Any*High HMO Penetration	-.08 (.23)	-.19 (.22)	.15 (.36)	-.06 (.07)	.55 ^b (.22)
3	Any	-.30 (.35)	.49 (.34)	.81 (.54)	-.04 (.12)	.32 (.33)
	Any*Physicians Per 1000	.0020 (.0013)	-.0016 (.0013)	-.0021 (.0021)	-.0003 (.0005)	.0000 (.0013)
	Physicians per 1000	.0306 ^a (.0065)	.0307 ^a (.0064)	.0071 (.0100)	.0017 (.0021)	.0073 (.0063)

Notes: Coefficients and robust standard errors (in parentheses) for dummy variables reported in terms of percentage points. Regressions also contain the non-HPA regressors listed in Appendix 3.A.

^a Significant at p<.01 level; ^b Significant at p<.05 level.

3.5 Conclusions

The analyses in this chapter point to the same general conclusions. First, there is limited evidence that if hospital-physician affiliations have any effect on the treatment of patients, it is to increase the provision of high-tech services, at an increased cost to patients and/or Medicare. Second, hospital-physician affiliations appear to have no effect

on patient outcomes. The general lack of findings is consistent with anecdotal evidence that HPAs have not had a significant impact on the clinical operations of hospitals or physicians. Given these results, there is little reason for policymakers, including antitrust officials, to anticipate substantial patient benefits -- either health benefits or financial benefits -- from these affiliations.

But this conclusion must be qualified for several reasons. One reason is that this analysis has been limited to heart attack patients. While previous studies have shown significant regional variation in cardiac treatment choices, treatment patterns for other conditions may be more susceptible to alteration as a result of financial or organizational changes. A second reason is that readmissions and mortality (or the lack thereof), while certainly important outcome measures, cannot capture improvements in the quality of life that may result from high-quality cardiac care. But perhaps the most important reason to be cautious about drawing firm conclusions from this study is that it includes five years of data dating from the early period of hospital-physician affiliations. While the popularity of HPAs has declined somewhat in recent years, many affiliations persist. It may be that over the next few years, hospital-physician affiliations will direct more of their effort toward improving the treatment of patients and controlling the costs of care. If so, they may begin to have more of a positive impact on patients.

For this reason, it is important that studies of hospital-physician affiliations continue. With more years of data, regression analysis may be able to better pinpoint the effects of affiliations -- or to track changes in these effects. More information, too, on the nature of these organizations, such as the number of physicians they involve and the sorts

of agreements they form, could help to better identify their effects.⁶⁹ Further research in this area could in the long term help health care providers develop organizations that facilitate improvements in the efficiency and quality of patient care. For now, however, it appears that hospital-physician affiliations have not significantly affected patient care.

⁶⁹ The American Hospital Association, in addition to private organizations, continues to collect information on hospital-physician affiliations. In more recent years, it has also collected data on the number of physicians involved in HPAs.

APPENDIX 3.A

OLS Regression Results for the Basic Set of Regressions

Variables	Catheter Within 90 Days		PTCA or CABG Within 90 Days		Log 90-Day Payments	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
IPA	.26	.19	.44 ^b	.19	.39	.29
PHO	.03	.19	.22	.19	-.03	.30
MSO	-.22	.17	-.21	.17	-.49	.27
ISM	.67 ^a	.18	.61 ^a	.18	.88 ^a	.28
Foundation	.30	.21	.32	.21	.63	.33
Equity	.06	.32	-.29	.32	-.14	.51
GPWW	-.11	.26	.14	.26	-.34	.40
Small						
Local	.01	.50	-.03	.48	1.08	.79
Local+BigPartner	-.05	.53	-.01	.51	.86	.84
Nonlocal	-.37	.79	.51	.75	1.63	1.24
Big						
Local	.91 ^a	.30	.68 ^b	.30	-.64	.46
Local+BigPartner	-.03	.34	-.10	.33	-.09	.51
Nonlocal	1.35 ^b	.54	1.40 ^a	.54	1.14	.83
1995	2.25 ^a	.16	2.73 ^a	.15	5.76 ^a	.24
1996	3.01 ^a	.18	3.58 ^a	.18	12.96 ^a	.29
1997	4.36 ^a	.22	5.13 ^a	.22	17.99 ^a	.34
1998	5.47 ^a	.26	6.34 ^a	.26	19.82 ^a	.40
0-100 Beds	.73	.52	-.52	.50	-.73	.82
100-250 Beds	.50	.30	.09	.30	.41	.48
For Profit	.44	.66	.91	.65	4.28 ^a	1.01
Government	.58	.63	1.12	.62	1.27	.96
Religious	.56	.46	-.46	.47	1.35	.71
Contract Managed	-.19	.46	.17	.44	.54	.72
Teaching	-.28	.37	.54	.38	.75	.57
5-15% HMO pen.	.24	.26	.09	.26	.37	.40
15-25% HMO pen.	-.21	.31	-.23	.31	.13	.48
25-35% HMO pen.	-.30	.37	-.20	.36	.04	.57
>35% HMO pen.	-.01	.42	.61	.42	.28	.67
Physicians per 1000	.0322 ^a	.0066	.0284 ^a	.0064	.0045	.0101
Female	-2.99 ^a	.22	-4.92 ^a	.24	-3.46 ^a	.35
Black	-12.15 ^a	.59	-18.35 ^a	.60	-15.21 ^a	.91
Age 70-74	-6.03 ^a	.18	-5.87 ^a	.20	-2.12 ^a	.30
Age 75-79	-16.81 ^a	.20	-16.04 ^a	.21	-8.80 ^a	.31
Age 80-89	-39.95 ^a	.18	-34.88 ^a	.19	-26.74 ^a	.29
Age 90-99	-63.02 ^a	.25	-50.74 ^a	.23	-42.28 ^a	.49
N	976,031		976,031		969,090	
R-squared	.1588		.1134		.0417	

Notes: Coefficients and robust standard errors reported in percentage points. Categories omitted from the regression include: not in system, 1994, more than 250 beds, less than 5% HMO penetration, and age 65-69. Coefficient estimates for demographic interaction terms and hospital fixed effects not presented.

^a Significant at p<.01 level; ^b Significant at p<.05 level.

APPENDIX 3.A, continued
OLS Regression Results for the Basic Set of Regressions

Variables	AMI Readmission Within 90 Days		90-Day Mortality	
	Coef.	S.E.	Coef.	S.E.
IPA	-.02	.06	-.04	.18
PHO	-.05	.06	-.13	.18
MSO	-.12 ^b	.05	.13	.16
ISM	.07	.06	.07	.17
Foundation	-.10	.06	.20	.20
Equity	.14	.10	.07	.30
GPWW	-.10	.08	-.10	.24
Small				
Local	-.02	.16	-.63	.49
Local+BigPartner	.08	.16	.19	.52
Nonlocal	-.32	.23	.00	.76
Big				
Local	-.08	.10	-.47	.28
Local+BigPartner	-.04	.11	-.07	.32
Nonlocal	-.09	.16	-.73	.51
1995	-.04	.05	-.49 ^a	.15
1996	.04	.06	-.32	.18
1997	.05	.07	-.76 ^a	.21
1998	.14	.08	-1.10 ^a	.25
0-100 Beds	-.09	.16	-.25	.49
100-250 Beds	-.11	.10	-.03	.28
For Profit	.28	.20	-.19	.65
Government	.00	.20	-.57	.61
Religious	.11	.14	.28	.44
Contract Managed	.11	.14	-.29	.45
Teaching	.14	.11	-.34	.35
5-15% HMO pen.	.01	.08	-.16	.24
15-25% HMO pen.	-.04	.10	.08	.30
25-35% HMO pen.	-.06	.11	.37	.35
>35% HMO pen.	-.06	.13	.06	.40
Physicians per 1000	.0015	.0020	.0067	.0063
Female	.18 ^a	.06	2.16 ^a	.17
Black	.37 ^b	.17	.41	.46
Age 70-74	.16 ^a	.05	4.34 ^a	.15
Age 75-79	.38 ^a	.05	10.34 ^a	.17
Age 80-89	.87 ^a	.06	19.97 ^a	.17
Age 90-99	.59 ^a	.12	33.36 ^a	.42
N	976,031		976,031	
R-squared	.0005		.0379	

Notes: Coefficients and robust standard errors reported in percentage points. Categories omitted from the regression include: not in system, 1994, more than 250 beds, less than 5% HMO penetration, and age 65-69. Coefficient estimates for demographic interaction terms and hospital fixed effects not presented.

^a Significant at p<.01 level; ^b Significant at p<.05 level.

APPENDIX 3.B.1

OLS Analysis: The Effect of Hospital-Physician Affiliations on
AMI Patient Treatments, Payments, and Outcomes
All Hospitals, 1993-1998

Indep. Variable: Affiliation Type	Catheter Within 90 Days	PTCA or CABG Within 90 Days	Log 90-Day Payments	AMI Readmission Within 90 Days	90-Day Mortality
IPA	.08 (.15)	.13 (.15)	.21 (.23)	-.02 (.05)	.07 (.14)
PHO	.47 ^a (.15)	.58 ^a (.14)	.35 (.23)	-.01 (.05)	-.28 ^b (.14)
MSO	-.06 (.14)	.03 (.14)	-.30 (.22)	-.13 ^a (.04)	.07 (.14)
ISM	.30 (.15)	.43 ^a (.15)	.17 (.24)	.09 (.05)	.14 (.15)
Foundation	-.01 (.17)	.15 (.17)	.10 (.27)	-.08 (.05)	.18 (.17)
Equity	-.04 (.29)	-.28 (.29)	-.29 (.45)	.11 (.09)	-.13 (.27)
GPWW	-.31 (.22)	.01 (.22)	-.46 (.35)	-.11 (.07)	-.04 (.21)
Mean	47.2	33.8	9.35	1.87	24.4
N	1,185,210	1,185,210	1,178,072	1,185,210	1,185,210
R-Squared	.1583	.1122	.0448	.0005	.0382

Notes: Coefficients and robust standard errors (in parentheses) reported in percentage points. Full model includes all of the variables reported in Appendix 3.A. In the 1993 data only, ISM, Equity, and GPWW were not reported, and have been set to zero. Omitting these variables from the regression altogether has little effect on the coefficients of the other HPAs.

^a Significant at $p < .01$ level; ^b Significant at $p < .05$ level.

APPENDIX 3.B.2

OLS Analysis: The Effect of Hospital-Physician Affiliations on
AMI Patient Treatments, Payments, and Outcomes
Urban Hospitals, 1994-1998

Indep. Variable: Affiliation Type	Catheter Within 90 Days	PTCA or CABG Within 90 Days	Log 90-Day Payments	AMI Readmission Within 90 Days	90-Day Mortality
IPA	.16 (.21)	.23 (.21)	.06 (.33)	-.04 (.06)	-.17 (.20)
PHO	.09 (.22)	.35 (.22)	.07 (.34)	-.04 (.07)	-.20 (.21)
MSO	-.13 (.18)	-.11 (.19)	-.24 (.29)	-.06 (.06)	-.02 (.17)
ISM	.55 ^a (.20)	.46 ^b (.20)	.75 ^b (.31)	.07 (.06)	.03 (.19)
Foundation	.38 (.23)	.46 ^b (.23)	.79 ^b (.36)	-.10 (.07)	.32 (.22)
Equity	.25 (.33)	-.08 (.34)	-.01 (.52)	.15 (.10)	-.10 (.31)
GPWW	-.19 (.28)	-.07 (.28)	-.21 (.43)	-.14 (.08)	.02 (.26)
Mean	51.1	37.1	9.42	1.84	23.8
N	753,874	753,874	747,910	753,874	753,874
R-Squared	.1609	.1142	.0378	.0006	.0379

Notes: Coefficients and robust standard errors (in parentheses) reported in percentage points. Full model includes all of the variables reported in Appendix 3.A.

^a Significant at p<.01 level; ^b Significant at p<.05 level.

APPENDIX 3.C
Instrumental Variables Results for the Basic Set of Regressions
(Low- and High-Integration Affiliation Treated as Endogenous)

Variables	Catheter Within 90 Days		PTCA or CABG Within 90 Days		Log 90-Day Payments	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
HPA Type:						
Low-Integration	91.40 ^a	31.59	133.04 ^a	37.63	154.65 ^a	55.19
High Integration	53.49 ^a	17.08	87.23 ^a	20.27	155.28 ^a	29.70
Small						
Local	-6.46 ^a	2.12	-9.88 ^a	2.52	-12.70 ^a	3.70
Local+BigPartner	-12.35 ^a	3.87	-18.88 ^a	4.61	-26.52 ^a	6.77
Nonlocal	-1.75	1.15	-1.25	1.36	.20	2.05
Big						
Local	-7.73 ^a	2.66	-12.51 ^a	3.16	-19.95 ^a	4.64
Local+BigPartner	-5.20 ^a	1.65	-8.26 ^a	1.96	-12.91 ^a	2.86
Nonlocal	-6.20 ^a	2.39	-10.12 ^a	2.84	-15.36 ^a	4.17
1995	-8.29 ^b	3.27	-13.34 ^a	3.88	-17.05 ^a	5.69
1996	-11.14 ^b	4.37	-18.05 ^a	5.19	-18.32 ^b	7.61
1997	-6.82 ^b	3.48	-11.96 ^a	4.14	-6.24	6.06
1998	-1.13	2.11	-3.72	2.51	6.11	3.68
0-100 Beds	-2.95 ^b	1.45	-6.05 ^a	1.72	-7.35 ^a	2.54
100-250 Beds	-1.29	.92	-2.31 ^b	1.09	-1.06	1.60
For Profit	16.23 ^a	5.01	24.23 ^a	5.96	35.86 ^a	8.73
Government	6.60 ^a	1.99	10.13 ^a	2.37	14.03 ^a	3.45
Religious	-8.42 ^a	2.82	-13.85 ^a	3.36	-17.35 ^a	4.95
Contract Managed	4.96 ^a	1.90	7.63 ^a	2.26	9.17 ^a	3.33
Teaching	3.58 ^b	1.69	5.76 ^a	2.02	5.09	2.93
5-15% HMO pen.	-3.99 ^a	1.33	-6.32 ^a	1.59	-8.94 ^a	2.31
15-25% HMO pen.	-4.89 ^a	1.47	-7.30 ^a	1.75	-10.44 ^a	2.55
25-35% HMO pen.	-5.23 ^a	1.59	-7.51 ^a	1.89	-10.15 ^a	2.76
>35% HMO pen.	-3.95 ^a	1.32	-4.97 ^a	1.57	-7.06 ^a	2.30
Physicians per 1000	-.0234	.0191	-.0549 ^b	.0227	-.1142 ^a	.0334
Female	-2.99 ^a	.26	-4.87 ^a	.32	-3.38 ^a	.46
Black	-11.99 ^a	.70	-18.07 ^a	.82	-14.54 ^a	1.21
Age 70-74	-6.01 ^a	.22	-5.79 ^a	.27	-2.01 ^a	.39
Age 75-79	-16.90 ^a	.23	-16.11 ^a	.28	-8.83 ^a	.41
Age 80-89	-39.91 ^a	.22	-34.80 ^a	.26	-26.65 ^a	.39
Age 90-99	-63.03 ^a	.35	-50.75 ^a	.44	-42.45 ^a	.73
N	981,755		981,755		974,695	

Notes: Coefficients and robust standard errors reported in percentage points. Categories omitted from the regression include: not in system, 1994, more than 250 beds, less than 5% HMO penetration, and age 65-69. Coefficient estimates for demographic interaction terms and hospital fixed effects not presented.

^a Significant at p<.01 level; ^b Significant at p<.05 level.

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